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THE CONDOR

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THE CONDOR

JOURNAL OF THE COOPER ORNITHOLOGICAL CLUB

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CONTENTS

		PAGE
Life in a Murre Colony, a photograph by Ed Harrison and Frances Roberts	opposite	161
Geographic Variation of the Screech Owls of the Deserts of Western North America,	*Alden H. Miller* and *Loye Miller*	161
Relationships Between Birds and Deer	*Thane Riney*	178
The Seasonal Occurrence of Shorebirds on Bay Farm Island, Alameda County, California	*Robert W. Storer*	186
Prior Description of Two Mexican Birds by Andrew Jackson Grayson	*Lois Chambers Taylor*	194
Breeding Seasons of Hummingbirds Near Santa Barbara, California	*Frank A. Pitelka*	198
FROM FIELD AND STUDY		
Nesting Density of Virginia and Sora Rails in Michigan	*Andrew J. Berger*	202
The Lucifer Hummingbird in the United States	*Walter P. Taylor* and *Allan J. Duvall*	202
A Summer Record of the Great Gray Owl in Oregon	*Stanley G. Jewett*	203
A Quail from the Oligocene of Colorado	*Harrison B. Tordoff*	203
Least Tern in Southeastern New Mexico	*Henri C. Seibert*	204
The Clark Nutcracker in San Diego County, California	*Bayard H. Brattstrom* and *James R. Sams*	204
Pleistocene Duck Bones from Ohio	*Hildegarde Howard*	205
The Painted Redstart at Santa Barbara, California	*Egmont Z. Rett*	205
Autumn Bird Notes from the Charleston Mountains, Nevada	*Warren M. Pulich* and *Allan R. Phillips*	205
The Identity of Two Asiatic Birds Recorded from Nunivak Island, Alaska	*Alexander Wetmore*	206
Pebble-dropping by House Sparrows	*Edmund C. Jaeger*	207
Yellow-billed Cuckoo in the San Bernardino Mountains, California	*John H. Baumgardt*	207
NOTES AND NEWS		208
COOPER CLUB MEETINGS		208

Life in a Murre Colony
Uria aalge californica

Photograph by Ed Harrison and Frances Roberts
Taken at Three Arch Rocks, Oregon
June 27, 1940

THE CONDOR

NUMBER 53 JULY-AUGUST, 1951 NUMBER 4

GEOGRAPHIC VARIATION OF THE SCREECH OWLS OF THE DESERTS OF WESTERN NORTH AMERICA

By ALDEN H. MILLER and LOYE MILLER

Screech Owls (*Otus asio*) occur widely across the deserts of the southwestern United States and the northwestern states of México. In these arid regions they range from the oak and piñon belts of the mountains down through the desert scrub habitat of the lowest basins and river valleys. Mesquite brush, even when well scattered and not more than six feet in height, and widely spaced palo verdes, ironwoods and the larger cacti are adequate plant cover for the desert races of this species. Nocturnal foraging for insects and rodents on or near the ground requires but sparse vegetation, and daytime concealment and nest sites are probably the needs that limit these owls to the vicinity of the dense, larger-trunked, even if low, desert shrubs or to the large cacti or streamside cottonwoods in which woodpecker cavities are frequent. In especially favorable terrain, male owls stationed on territories may be spaced less than one hundred yards apart, although the interval is more commonly two hundred to four hundred yards. They are, then, an abundant small raptor, much more abundant, and hence we may say more successful, than their diurnal raptorial counterparts of the same areas, the Sparrow Hawks, Loggerhead Shrikes and Road-runners.

The area of concern in our study of Screech Owls lies south of central Nevada and Utah, west of the continental divide in the main, and east of the desert divides of southern California; it extends south through Sonora and Baja California. This area is essentially the lower Colorado River drainage basin and the watersheds of the trough of the Gulf of California. Some adjoining parts of the Great Basin region are involved.

In this area and about its margins eight races of Screech Owl are currently recognized. It is not proposed that any more be recognized, although one does require renaming. The object of our study has been, then, to clarify the nature of the differences in the races, to describe the clines in characters running through the complex and their general environmental correlations, and to indicate the points of maximum change in characters which may serve as somewhat arbitrary race boundaries. The races involved in the area are *Otus asio cineraceus* in the northeast, *O. a. suttoni* marginally in the southeast, *O. a. sinaloensis* in southern Sonora, *O. a. gilmani,* herein renamed, in the center of the Colorado trough, *O. a. inyoensis* in the Great Basin, *O. a. quercinus* on the western desert border, and *O. a. cardonensis* and *O. a. xantusi* in the central and southern parts of the peninsula of Baja California.

Special effort has been exerted for a period of twenty years to collect western Screech Owls in order better to understand the wide range of racial variation in this species. The impetus for this work came from the realization that these owls could be taken in numbers much greater than formerly by nocturnal hunting employing the whistled imitation of the principal trilling note of the western races to induce aggressive calling, and often approach, on the part of the owl. Use of this technique was begun by Loye Miller and independently by Edouard C. Jacot and in time it was adopted by a number of other field students. Among those whose nocturnal activity has also contributed extensively to the collections now before us are Joe T. Marshall, Jr., Alden H. Miller, Ward C. Russell and A. J. van Rossem.

In 1944 van Rossem and Loye Miller began a series of special trips into the deserts of California, Arizona, and Sonora in order to collect Screech Owls and pursue a revisionary study of the group. Van Rossem assembled loan material at the Dickey Collections in Los Angeles with the result that by 1949 there was present there a total of 365 adult specimens pertaining to the deserts and their peripheries, almost half of which had been taken by Loye Miller and van Rossem in recent years. The untimely death in 1949 of van Rossem, who was to have prepared the report, left on record only a partial set of measurements and occasional indications of his views on identifications on the measurement sheets. Some of these were interpretable from verbal comments he had made to the present authors. Utilization of the unique assemblage of Screech Owls seemed not only mandatory but challenging, and accordingly Alden Miller began periodic study of it in 1949. Use was made also of 73 specimens at the Museum of Vertebrate Zoology additional to those previously borrowed by van Rossem. Thus a total of 438 birds bearing on problems in the area has been employed.

For the loan of specimens we are greatly indebted to the following persons and institutions: The University of Arizona, the Museum of Northern Arizona, Joseph Brauner, the Chicago Natural History Museum, Robert G. Hannum, Lyndon L. Hargrave, Lawrence M. Huey, Randolph Jenks, the Los Angeles Museum, the Museum of Zoology of the University of Michigan, Gale Monson, Allan R. Phillips, the late Max M. Peet, the San Diego Society of Natural History, William J. Sheffler, the United States National Museum (Biol. Surv. Coll.), and the University of Utah.

The large group of specimens available to us has served to develop an appreciation of the great range of individual variation in Screech Owls, both in color and dimensions, which early workers with small series could scarcely gain. As a consequence certain names based on small samples and slight individual variations can now be assigned to synonymy with some confidence. It is thought that naming of such variants and of intergrading stages badly obscures and distorts the main pattern of geographic variation.

The sex ratio in the collections is influenced by the greater readiness of males to respond aggressively to imitated calls. The most thorough comparison of geographic samples can, therefore, be made in this sex. However, in some areas, such as the Tucson district and the Cape district of Baja California, many Screech Owls were taken by climbing to nest and roost holes before nocturnal hunting was much in vogue. Consequently females are better represented or even predominate slightly in the samples from these areas.

GEOGRAPHICALLY VARIABLE CHARACTERS

Color and pattern.—In dealing with the extremely variegated and complex color patterns of owls, it is difficult to make comparisons and focus attention on comparable parts in different specimens and series. Mass effects of contrast are often readily seen but are troublesome to analyze. On the dorsal surface the principal geographic variables are: (1) the width and intensity of the dark shaft streaks, which are always more prominent on the head than on the back and which especially on the head increasingly dominate the pattern as seasonal wear proceeds; (2) the hue and shade of the grays and browns that chiefly in mottled form make up the principal background color of the back; and (3) the hue and tint of the light tawny or essentially white areas, especially where they are prominent in the neck region.

On the face and ventral surfaces the variables are: (1) the amount and purity of the white which predominates in the face, especially at the margins of the ocular-auditory disc; (2) the width of the black shaft streaks of the ventral surface, which are always two to three times wider on the breast than on the flanks; those of the same section of the flanks, for example, may vary geographically from 0.5 to 2.5 mm. in width; (3) the

number and width of the black cross bars lateral to the shaft; a given flank feather may have as few as four irregularly spaced and curved bars to as many as eight, either solid or partly broken bars; (4) the presence or absence of a brown or yellow-brown area bordering the shaft; (5) the light background color, which may be light gray, nearly pure white, or slightly tawny. The crural feathering, and to less extent that of the lower flanks shows a greater amplitude of variation in background color than other ventral parts; it ranges from white to dark gray or to rich tawny or brown. Also the bars and spots of the crural area, usually in correlation with the background color, may be sparse and small or heavy to a degree that they dominate the area.

Among the Screech Owls of the deserts, we have seen no instance of phase or polymorphic color variation like that well known in the eastern races of the species. The bright red-brown phase is lacking. On a very different level of magnitude is graded indi-

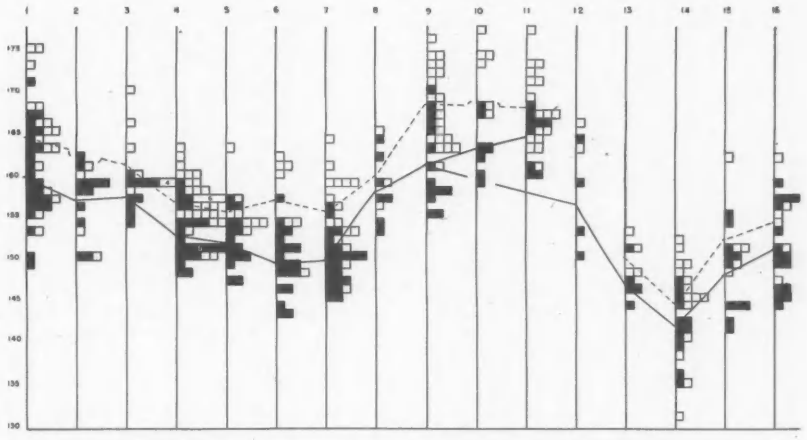

Fig. 1. Wing lengths of Screech Owls in millimeters. Solid squares individual males, open squares females. Each vertical line with number marks a separate geographic sample (see fig. 2 and note on page 164). Solid lines connect averages of males, broken lines females.

vidual variation in most western races involving gray and somewhat more tawny or brownish extremes (see p. 174). This variation is of the same order as that found in large samples of many bird species. It is equivalent to that in races of Song Sparrows and Savannah Sparrows.

Size.—Wing length, taken as the chord, proved to be the only worthwhile measurement to analyze. All specimens were remeasured by Alden Miller; his measurements were found to parallel but not always duplicate those made by van Rossem. Van Rossem had measured the tail, tarsus and middle toe without the claw on about half the assemblage. His record of foot measurements showed almost no hint of significant geographic variation except for slight tendencies parallel to the general size variation that is reflected by the wing measurement and some few weight records. Because of this and the great difficulty of making consistent foot measurements on a feathered foot surface, these variables were not further studied. Van Rossem's measurements of tail showed a parellel, individually and geographically, with wing length such that it did not seem profitable to undertake an independent set of measurements of this member.

The wing length apparently reflects a general size variation, although we must warn that this is only broadly true and the relation can not be established precisely without correlating wing length with some adequate set of measurements of body mass. Weight records are few, as they were not made by van Rossem and Loye Miller. Where they are available a strong parallel to wing length variation is indicated. For example, males and females of *inyoensis* average 164.5 and 168.0 mm., respectively, in wing length and 130.8 and 157.1 grams in weight; in *xantusi* males and females are 141.7 and 144.5 in wing length and 89.4 and 113.9 grams in weight. Thus in size (weight) *inyoensis* and some others of the larger races in this region are approximately 40 per cent larger than the dwarf *xantusi*, a rather amazing differential. The wing length differential is similar

Wing Length and Weight in Desert Populations of *Otus asio*

Population number (see names[1])	Wing length in millimeters: Number of specimens	Average	Standard deviation	Weight in grams: Number of specimens	Average	Standard deviation
			Males			
1	21	160.0	5.38	....	.....	.....
2	12	157.1	.....	....	.....	.....
3	10	157.5	.....	....	.....	.....
4	26	152.8	3.08	....	.....	.....
5	16	151.9	3.03	....	.....	.....
6	20	149.5	3.70	....	.....	.....
7	23	149.7	3.00	6	102.7	11.35
8	7	158.0	.....	4	115.9	.....
9	14	161.4	5.02	....	.....	.....
10	7	163.1	.....	....	.....	.....
11	9	164.5	3.13	8	130.8	9.20
12	4	156.5	.....	3	118.9	.....
13	5	146.8	.....	....	.....	.....
14	12	141.7	3.64	2	89.4	.....
15	11	147.8	4.85	....	.....	.....
16	16	151.1	5.06			
			Females			
1	17	164.6	6.37	2	133.5	.....
2	4	156.0	.....	....	.....	.....
3	9	161.4	.....	....	.....	.....
4	30	156.8	3.09	....	.....	.....
5	8	155.6	.....	....	.....	.....
6	7	157.1	.....	....	.....	.....
7	16	155.6	4.73	....	.....	.....
8	3	160.0	.....	....	.....	.....
9	21	168.4	4.40	....	.....	.....
10	6	172.2	.....	....	.....	.....
11	17	168.0	4.32	2	157.1	12.32
12	2	164.5	.....	....	.....	.....
13	4	150.0	.....	....	.....	.....
14	15	144.5	5.72	3	113.9	.....
15	5	152.2	.....	....	.....	.....
16	6	154.2	.....	....	.....	.....

[1] *Geographic groupings used for measurements* (for outlines of areas see corresponding numbers on map, fig. 2).—1, southeastern Arizona and southwestern New Mexico, largely the Chiricahua Mountains; 2, Huachuca; 3, Prescott; 4, Tucson and Phoenix; 5, Álamo, Salome and Harquahala; 6, Sonoyta; 7, Colorado River valley; 8, Little San Bernardino Mountains; 9, coastal southern California; 10, Tehachapi and Walker Pass; 11, Owens Valley and Carson Sink; 12, northwestern Baja California; 13, El Rosario, Baja California; 14, Cape district, Baja California; 15, Guaymas area and southern Sonora; 16, central Sonora.

but does not reflect fully the magnitude of the difference in mass in these extreme races.

Sexual differentiation in plumage has not been detected. The greater average size of females has long been known, but we had not realized how extensively males and females overlap in wing length until the large series of measurements now assembled were compared (fig. 1). Females average only about three per cent longer winged in most populations. Weight also overlaps, although apparently to less extent, but the record is insufficient to establish the relationship precisely.

No means has been found of determining the age of owls subsequent to the period in the early fall when all remnants of juvenal body plumage are lost.

CLINES

Wing length shows a striking cline in which there is decrease from north to south and from higher terrain east and west of the lower Colorado River valley down slope into the trough of the valley. The resultant axes of the cline in Arizona and eastern California are therefore southwest and southeast to a point of low value in the Colorado River valley at elevations below 500 feet. The more southern populations of central coastal Sonora are not significantly smaller, and those of extreme southern Sonora are but slightly further reduced in wing length. Southward along the peninsula of Baja California wing length drops to a low extreme in the Cape district. As indicated earlier wing length reflects body size and the cline of decreasing wing length probably has chief significance as an imperfect index of change in body size; independent modification of wing length, although probably extant, is not readily made out and in any event appears not to be large. Thus, there is no basis for relating the wing length cline to Allen's principle, positively or negatively. The evident size cline reflected by wing and weight is, however, strikingly in accord with Bergmann's principle. Decreased size correlates both with southern warmer latitudes and lower warmer elevations in the desert.

Screech Owls throughout the area under consideration feed chiefly on arthropods, especially large ground-dwelling forms. Only occasionally are small rodents taken. Possibly rodents are more often depended on, especially in winter, in the populations at more northern points and at higher elevation. Conceivably large size would be an advantage in this connection, but diet differential is at this time only surmised and remains to be established.

Screech Owls, so far as evidence indicates, are essentially nonmigratory (there may be some rather local shifting). In winter in cold areas the birds seem to be very inactive on many nights and especially when there is wind and storm. At these times they respond poorly to calls. We can not escape the notion that owls that must move about at night and be subject at that time to the convectional factor to great degree have more of a problem of heat loss than do diurnal animals in the same latitude or climatic area. Also it is noted that heavy fat deposition is frequent in them by late fall. These several circumstances suggest that there is a particularly acute need for heat and energy conservation in winter. If a Screech Owl is to be quiescent for many days during unfavorable weather and consequently feed but little, a favorable surface-mass ratio, such as exists in large-sized individuals, would be distinctly advantageous. Certainly the winter nights at 4000 feet in the Great Basin and in the desert mountains of California and Arizona are more severely cold than those of the Cape district of Baja California where frosts are rare indeed at low elevations.

Coloration shows several independent gradations. Brownish hue in the dark background color of the back, in the crural area, and on the borders of the shaft streaks of the ventral tract diminishes fairly abruptly eastward across the desert divides of southern California and gives way to light gray back and to light tawny or yellowish shaft-

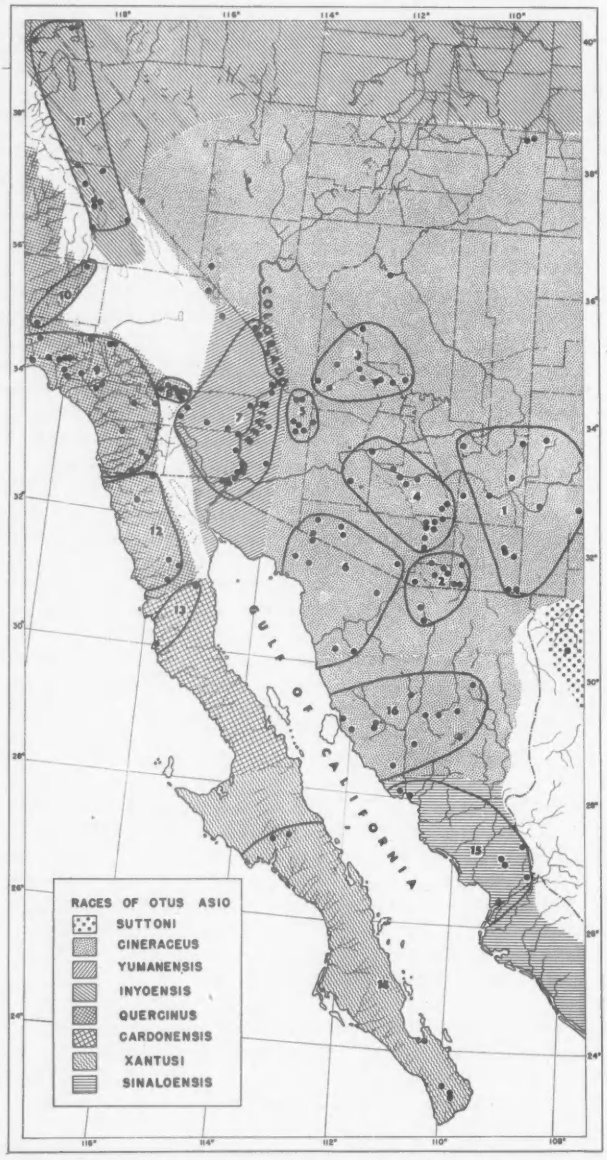

Fig. 2. Distribution of desert races of Screech Owls, each race marked by style of shading. Dots show localities from which specimens were examined. Encircled areas with numbers mark geographic units used in comparisons (see page 164).

streak borders and crural background color. At the same time the whitish background of the underparts becomes whiter. Immediately east of the Colorado River valley, the back begins to be more neutral and darker gray, and ochre and tawny hues disappear from the lighter areas both above and below. Cold dark grays combined with light gray background colors gradually becomes more dominant in the populations farther eastward and occasionally are more extremely manifest. A considerable increase in this tentency results in the race *suttoni* of the plateau of Chihuahua.

Northwestward in the Inyo district and on into western Nevada, white background becomes purer and white facial marks are whiter and more extensive; otherwise the birds are similar to those of Arizona east of the Colorado River and to intermediate stages along the gradient from coastal southern California to the Colorado River valley. South of Arizona, dark, neutral grays and dull whites prevail until in central Sonora the grays become darker and browner, and rufous brown appears in the crural area and flanks. On the peninsula of Baja California grays become paler in the southern half.

Viewed broadly, then, colors are less brown and tawny and grays are lighter and whitish areas purer in the most arid regions, as in the Colorado River valley, the Owens Valley and the southern part of Baja California. Darker grays with even less tawny or brown hues prevail eastward in the less severely arid regions both at low elevations and in the mountains.

The breadth of the shaft streaks on the crown and on the underparts shows gradients that parallel size; large Screech Owls are boldly marked, small ones narrowly striped. It is not impossible that there is a partial common regulation or genetic determination of these features, yet there is at the same time no perfect correlation of the two in intraracial variation and each may be presumed to be independently modifiable to a degree. Shaft streaks are broad in all groups bordering the Colorado basin, including *inyoensis*, and diminish in converging gradients toward the lower valley; the streaks are also narrow in *xantusi* of the Cape district and in *sinaloensis*. More or less associated with this cline is the condition of the lateral feather bars on the ventral surface; these bars are broader and more continuous in correlation with broader shaft streaks. The number of lateral bars per feather is independent of width. The number is low in *mccallii* of Texas and is consistently high in *sinaloensis*, but there is considerable individual variation in number through most of the populations in the area under study. In *sinaloensis* the lateral bars are disproportionately heavy compared with the shaft streaks and are also numerous, giving a densely barred, almost reticulate effect in extreme individuals.

The broad aspects of the color cline and that of the streaking have a measure of environmental correlation which in turn may reflect adaptive significance. This significance probably does not extend to local aspects of the gradients nor to the precise combinations of pattern and color features. These details may be influenced by infiltration or flow effects from adjoining faunal areas, by historic factors, and by the chance availability of mutants and the chance fixation of them. Paler, duller colored, less boldly striped Screech Owls should be less conspicuous on their daytime roosts (not all roost in holes) in the desert vegetation and at crepuscular hours than birds possessing the opposite extremes of coloration and pattern which should in turn be less conspicuous in oak or oak-pine woods by reason of their dark, bold and varied markings.

In the elaborate immobile concealing posture assumed by alarmed Screech Owls, the ear tufts are extremely elevated (perhaps this is the main reason for their existence) and the facial disc and eye slits are arranged so as to distort the normal strigine outline and pattern. This can scarcely have been evolved except under considerable selection pressure. Anyone encountering this posture in an alarmed owl on a daytime roost, or for that matter at night, can not escape noticing the strong concealment aspect of it. Re-

semblance to odd-shaped masses of foliage or to bark fragments or trunk surfaces is striking. In a certain percentage of cases, and the percentage need not be large to be effective, this concealing aspect must lead to failure to detect on the part of carnivores and man. Wildcats, coyotes, foxes, and larger owls that could get at Screech Owls in low desert vegetation must surely be deceived occasionally. And Screech Owls, unlike Pigmy and Horned owls, are easily struck down and injured once they are detected. They do not have the stamina of some of their relatives to survive minor injury and escape.

General resemblance in color to the prevailing light gray of desert foliage must be an effective part of this general concealing mechanism no matter how the owl's pattern is worked out in detail. Fine striping more generally corresponds with the shadows of bare twigs and narrow, reduced desert leaf types than it does with those cast by broad-leaved trees.

The gradients in color and pattern do not break sharply at zonal or plant-belt borders, yet there is a rough or partial correspondence, as through the Joshua Tree National Monument in passing from the piñon-oak belt down into the mesquite and ironwood to the eastward, or in Arizona in passing down mountain slopes from the oak-pine country into the palo verde, mesquite and sahuaro association. Imperfections are evident, for the darker gray, broad striped, *cineraceus* types spread far out westward in Arizona beyond the larger mountains, but in a sense such an imperfect correlation is what one would expect where selection for concealment is in no sense absolute and full continuity of populations permits gene flow.

The color clines have a general correspondence with the trends subsumed under Gloger's principle. But more important than the mere correspondence with this dictum is the fact that in this instance we may reasonably interpret the correspondence as one directed by selective forces working in favor of concealing coloration. The correlation of color with temperature and humidity as outlined by Gloger's principle is only secondarily causal, the background colors being determined by these climatic factors, and these in turn setting up selective forces working on the owls. This sort of relation is probably general, as now often assumed, in instances of variation that conform to Gloger's principle.

GEOGRAPHIC RACES

Otus asio suttoni Moore

Otus asio suttoni Moore, 1941:154.

Type locality.—Portezuelo, Hidalgo, México, about 5800 feet (type in coll. R. T. Moore).

Range.—Central Plateau of México, from Hidalgo northwest to Chihuahua.

Characters.—Resembles *Otus asio cineraceus* of Arizona and New Mexico but ventral markings coarser and more sharply contrasting black and white; back darker, more neutral, "colder," gray. Wing length and weight same as in *cineraceus* of eastern Arizona and western New Mexico.

Specimens examined.—Two. CHIHUAHUA. Ramos, 4800 feet [near Casas Grandes].

The distinctness of this form from races bordering it to the south and east has not been investigated, but we have no reason to doubt its validity. The large size claimed for it by Moore is not substantiated, however, particularly in comparison with *cineraceus*. The understanding of wing length variance in *cineraceus* developed in the present study and the measurements of the two Chihuahuan examples of *suttoni* we have had at hand indicate that the dimensions of *suttoni* fall well within those of *cineraceus*.

No light can be thrown on the relations of *suttoni* to *O. a. vinaceus* of the mountains of central western and southwestern Chihuahua. The coloration of the specimens from Ramos in the Chihuahuan desert plateau does not in any way suggest that ascribed to *vinaceus*.

Although the area east of the continental divide has been given little consideration,

examples of *cineraceus* have been examined from Dona Ana County, southern New Mexico, and from Culberson and Jeff Davis counties in western Texas. These birds and those from the area about the border junction of Arizona, New Mexico, and Sonora as a group are not as extremely black and white nor as cold gray as the specimens from northern Chihuahua. They agree well with *cineraceus* of the Chiricahua mountain area (see also Van Tyne and Sutton, 1937:36). One of three individuals from Jeff Davis County does, however, approach the Ramos specimens. Although intergradation of *cineraceus* with *suttoni* is not adequately localized by these specimens, it is evident that the most definite change in coloration takes place at or slightly south of the international boundary in Chihuahua.

Otus asio cineraceus (Ridgway)

Megascops asio cineraceus Ridgway, 1895:390.
Otus asio gilmani Swarth, 1910:1.
Otus asio mychophilus Oberholser, 1937:356.

Type locality.—Northwestern Mexico and contiguous border of United States, in Arizona and New Mexico . . . . Lectotype from Fort Huachuca, [Cochise County,] Arizona (in U. S. Nat. Mus).

Range.—Southern Nevada south of latitude 38° (exclusive of lower Colorado River valley), southern Utah (northeast at least to northern San Juan County), probably southeastern Colorado, and southwestern New Mexico (south and west from Socorro County), south throughout Arizona, except the Colorado River valley south of Fort Mojave area, to central Sonora (intergradation with *sinaloensis* occurs in the Guaymas area) and to western Texas west of the Pecos River.

Characters.—A gray and black, moderately large form with finer, more numerous dark cross bars on ventral plumage than in *aikeni* and *mccallii* to the eastward and with coarser shaft markings than in the smaller desert races to the southwest. Brownish and tawny hues less evident than in the Colorado River valley and Pacific coastal forms of California and than in *aiken* and *mccallii*. Crural barring heavier and background darker, less white or pale tawny than in Colorado River valley form and *inyoensis*, but less extensive and less brown than in *sinaloensis*.

Specimens examined.—Two hundred and forty-seven. NEVADA. Nye County: 2½ mi. E, 1 mi. S Grapevine Peak, 6700 ft. (2 specimens). Lincoln County: Ash Spring, 3800 ft., Pahranagat Valley (1). Clark County: north side Potosi Mt., 5800 ft. (2). CALIFORNIA. San Bernardino County: southeast side Clark Mt., 6300 ft. (1). UTAH. San Juan County: 16 mi. S Moab (1); 19 mi. SE Moab (1). ARIZONA. Yuma County (intermediates): Alamo Crossing, Bill Williams River, 1200 ft. (6); 3 mi. E Alamo Crossing (3); Salome (1); 10 mi. S Salome (1); Reed Ranch, 6 mi. SE Salome, 1650 ft. (7); 8 and 13 mi. SE Salome (2). Coconino County: Grand Canyon Village (1); 10 mi. N Ashfork, 6000 ft. (2). Yavapai County: 3 mi. E Big Sandy River (Crosby Ranch), 3200 ft. (1); Bagdad Bridge, Santa Maria River, 2300 ft. (2); Camp Wood (1); Williamson Valley, 4837 ft. (1); Prescott (1); Ash Creek, 4500 ft. (10); Dewey (1); Camp Verde (1); 2 mi. E Montezuma Wells, Palo Verde Valley (1 jv.). Maricopa County: Golden and North canyons, Harquahala Mts., 2600 ft. (8); Gila Bend (1); Phoenix (6). Pinal County: Santan (1); Blackwater (2); 3 mi. W Coolidge (2); 8 mi. S Coolidge (1); Florence (2); Mammoth (2); 2 mi. E Oracle, 4500 ft., Santa Catalina Mts. (1); Pepper Sauce Canyon, lower Santa Catalina Mts. (1). Pima County: east slope Santa Catalina Mts. at "lower control" (1); 12 mi. NE Tucson, Sabino Canyon (4); 5 mi. N Tucson (3); Fort Lowell (14); Tucson (17); 9 mi. E Tucson (1); San Xavier (2); 20 mi. S Tucson (1); Thomas Canyon, Baboquivari Mts., 4100-4700 ft. (6); 9 mi. N Menager's Dam (1); Alamo Canyon, Ajo Mts. (4); southeast end of Growler Valley (1); 1 mi. N Int. Boundary at Sonoyta (4). Santa Cruz County: Santa Rita Mts. (1); Florida Canyon, Santa Rita Mts. (1); Madera Canyon, Santa Rita Mts. (1); Sonoita (1); 10 mi. E Patagonia (1); 2 mi. S Patagonia (1); Peña Blanca Spring (6). Cochise County: Carr Canyon, 5300 ft., Huachuca Mts. (2); Sunnyside Canyon, 5800 ft., Huachuca Mts. (1); 1 mi. S Fairbank (1); Bonita Canyon and Pinery Canyon, Chiricahua Mts. (9); Chiricahua Mts. (6); Paradise (2); San Bernardino Ranch, 3717 ft., Mon. 77 (4); extreme southeast Arizona at Sonora boundary, 4000 ft. (2); Guadalupe Mts., 5200 ft., at Arizona-Sonora corner (1). Gila County: Cassadero Spr., 23 mi. ENE Globe, 4050 ft. (1). Graham County: Aravaipa Creek [Klondyke] (2); 3 mi. NW Safford (1). Greenlee County: Blue (1); ½ mi. S Granville, 6500 ft. (1). NEW MEXICO.

Socorro County: 2 mi. N Valverde, Rio Grande River (2). Catron County: Reserve (13). Grant County: Redrock (3); Mimbres River (2). Dona Ana County: Cox Ranch, west side Organ Mts. (1). TEXAS. Culberson County: McKittrick Canyon, 8 mi. NE Guadalupe Peak, 5300 ft. (1). Jeff Davis County: 1 mi. N Fort Davis, 4800 ft. (3). SONORA. Quitobaquito (2); 37 mi. SW Sonoyta (1); 19 mi. S Sasabe (2); 12 mi. W Caborca (1); 3 mi. E Caborca (5); Casita, 40 km. S Nogales (2); Quelita (1); 4 mi. N Moctezuma (2); 5 mi. E Masocahui (2); 15 mi. W Ures (1); 27 mi. W Ures (2); 5 mi. W Carbo (2); Sierra de Mazatan, 6 mi. N Nácori (1); 16 mi. S Hermosillo (1); 35 mi. W Hermosillo (3); 27 mi. E Kino Bay (5); 6 mi. NE Kino Bay (2); Sierra Seri (1); 15 E Estero Tasiota (4).

The boundaries of this form to the north and east have not been extensively investigated and they are only approximately indicated by a scattering of specimens available. If the range is incorrectly indicated in these directions, the error probably consists of not extending it far enough. In Nevada the junction with *inyoensis* must take place north and west of Death Valley, but there is a gap in the representation of specimens between the piñon belt east of Death Valley, whence two worn birds seem a little closer to *cineraceus* than to *inyoensis*, and the northern Owens Valley and Carson Sink areas where *inyoensis* is typical. We have seen nothing to indicate the point of junction of these races in Utah.

Oberholser described *Otus asio mychophilus* from the south rim of the Grand Canyon and indicated its extension far into Utah to Provo and Moab. We have had available one topotype of *mychophilus* and one of us has seen the type specimen in the United States National Museum. Also, two birds from near Moab in San Juan County, Utah, have been carefully compared. In none of these can we see any significant departure from the normal types of variants in *cineraceus*. Oberholser's principal comparison of *mychophilus* was with *inyoensis* and the points of difference he indicates are among those by which *cineraceus* differs from *inyoensis*. Contrasted with *cineraceus*, he claims it to be of much larger size, with darker and usually more uniform and more finely vermiculated upper [*sic*] surface. The color characters may have been indicated in the particular samples Oberholser had before him, but are completely encompassed within the range of individual variation of *cineraceus* as adequately demonstrated in large series. Indeed the direct comparison of the types of *cineraceus* and *mychophilus* in Washington failed to show any color differences other than those of a normal sort that may be seen in many different population samples of *cineraceus*.

In size the topotype male of *mychophilus*, by our measuring, shows a wing of 162 mm. and the two females from the Moab area, Utah, are 168 and 173 mm., respectively. A comparison of these with values shown in the table (p. 164) and figure 1 indicates that they fall well within the range of *cineraceus* of the southeastern Arizona area, a population which in size is but slightly larger than that in the vicinity of the type locality of *cineraceus*. Although no two workers' measurements can be expected to conform minutely, Oberholser's published figures for *mychophilus* also appear to agree well with the larger eastern and northern extreme populations of *cineraceus*. These slight trends in size, part of extensive clines, are not at all adequate for definition of separate races in a practical nomenclature.

Cineraceus at its eastern limits gives way to more openly barred and streaked and less pure gray populations—the *aikeni* and *mccallii* types; these limits can not be localized now. The samples of *cineraceus* from southwestern New Mexico represent no trend in this direction but merely a slightly higher proportion of the more heavily striped and neutral gray variants than in central Arizona; there is no major alteration of pattern in them that approaches the condition in *mccallii* which, for example, regularly develops flank feathers with only four or five cross bars. (See p. 169 concerning approach to *suttoni*.)

For a great many years there has been the assumption that in Arizona one race of Screech Owl, the *cineraceus* type as now understood, occupied the oak and lower pine country—the Upper Sonoran Zone—of the mountains of the central and eastern sections and that a low desert race, which Swarth named *gilmani*, occupied the mesquite and sahuaro belts westwardly to the Colorado River. Swarth at various times (1904, 1910, 1914) developed this picture and there is a fundamental truth in it, for a comparison of opposite extremes of birds from the oak belts of the Chiricahua and Huachuca mountains and the bottom lands of the Colorado River valley show a strong contrast in size and in depth of coloration, hue, and fineness of markings. What could not be well seen until large, geographically diversified samples were assembled was that there was no sharp correspondence of these characters with zonal boundaries and that in the central lowlands there are mixtures of the types of color and pattern, these mixtures shifting gradually in proportion toward one extreme to the west and another to the east. Indeed the extreme populations show similar ranges of individual variation but each has a different assemblage of variants which does not overlap the extreme at the opposite end of the cline.

It becomes evident that in size and color the population of eastern Arizona and western New Mexico is on the average slightly more extreme than that centering about the type locality of *cineraceus* in the Huachuca district and than that of the Prescott district. But the Chiricahua and Huachuca groups so fully overlap that no distinction at the level of a two-thirds separation exists and thus no distinction of taxonomic worth is present.

Similarly in comparing the Huachuca group with that of the Tucson area (formerly classed as *gilmani*) a moderate average decrease in wing length is noted and a number of lighter gray and some earthy gray birds appear as well as those with finer shaft stripes, yet there are in the Tucson group many, including proved breeding birds, that in color and size are identical with examples from the Huachuca and even the Chiricahua and New Mexican areas. The size and average color make-up of the population in the Phoenix area is so similar to that of the Tucson group that the samples were combined for the plotting of wing length.

Farther westward toward the Colorado River trough and southward to the Sonoyta area size further diminishes gradually, but coloration changes rather little until close to the Colorado River. The birds of the Alamo area on the Bill Williams River and those from the vicinity of Salome are essentially the same in range of color as the Phoenix and Tucson groups, but coarsely striped and dark gray variants are few. Then, rather abruptly in the Colorado River valley proper, dark gray, heavily striped birds disappear from the samples and even more extremely pale, fine striped and light buffy gray variants appear. There is then a fairly distinct break in the general color cline within twenty-five miles of the river valley and only about 25 per cent of the sample from the Colorado Valley overlaps in color the paler, more finely striped extremes of the Salome, and Alamo intermediate groups. It is at this point that the race boundary must logically be set as it is the one steep section in the color cline; there is no sharp break anywhere in the wing length cline.

It is most unfortunate that Swarth in perceiving the general outlines of this geographic variation and intending to name the desert race of the area did not select a type from the Colorado River valley. The reason probably is that he had very scant material from this valley in 1910. Thus he chose a type from Blackwater, some 35 miles southeast of Phoenix, from which vicinity he had several recently taken specimens provided by M. French Gilman. The type of *gilmani* has been compared many times by van Rossem and by us with the present assemblage of Screech Owls. Two main points emerge:

(1) it is not representative of the average of the Phoenix and Tucson groups, most of which are purer gray dorsally, but it is one of the somewhat earthy brown variants of these groups of Screech Owls which are uncommon yet present throughout most of the populations of *cineraceus*. (2) It does not possess the light tawny hues of the Colorado River valley birds nor the nearly pure white background of the underparts and the fine striping. In other words the type is not identifiable with the Colorado River valley form although it shows in its brownish gray color some parallel to the light warm gray color of that race. No alternative exists but to relegate *gilmani* to the synonymy of *cineraceus* even though it is a fairly well known name and was intended by its describer to include the Colorado River bird, the extreme differentiation of which he did not, and probably could not, at that time discern. A new name is therefore supplied (see below) to represent the extreme or end point of the color and size clines running both from the northwest and northeast into the Colorado River trough.

South of Arizona through the coastal and lower mountain districts of northern Sonora coloration does not seem to alter significantly. Occasional pale, fine-striped birds suggestive of the Colorado Valley form appear, but they are rare. The size remains at the low level of the Sonoyta group. Thus, we encounter owls of the general coloration of *cineraceus* and the small size of the Colorado Valley form. However, the size (or wing length) so broadly overlaps that of the typical populations of the Huachuca area as to rule out nomenclatural distinction.

Size further declines a little grading into *sinaloensis* of southern Sonora. Beginning even as far north as Moctezuma, near latitude 30°, occasional birds appear that are darker and browner above and below than *cineraceus* and suggest *sinaloensis*. Not until the Guaymas area is reached, however, do several dark colored, fine striped and densely barred birds appear. The population here may be regarded as intergradient, perhaps as a whole closer to *sinaloensis*. Even in extreme southeastern Sonora in a *sinaloensis* population, one *cineraceus*-like individual has been taken 17 miles northeast of San Bernardo. This bird may be a migrant but just as probably it is an individual variant of a resident population.

Otus asio yumanensis new subspecies

Type.—Male, no. 52107 Museum of Vertebrate Zoology, taken 10 miles west of Pilot Knob, 1 mile south of Mexican Boundary, Baja California, March 15, 1928, by Chester C. Lamb; weight 102.5 gm.

Range.—Lower Colorado River Valley from vicinity of Fort Mojave in extreme southern Nevada and western Arizona south to the delta in Sonora and Baja California and the Colorado Desert of California west to Shaver's Well (near Mecca).

Characters.—Similar to *Otus asio cineraceus* but size smaller (see fig. 1 and table); back light, less neutral gray, and the light areas of nape more ochraceous. Stripes of crown narrower and dark wing bars paler. Ground color below less gray and more yellowish, the flanks and legs usually yellowish or pale tawny. Dark stripes of breast narrow, usually bordered slightly with yellow-brown.

Specimens examined.—Forty-three. NEVADA. Clark County: Fort Mojave (2); ½ mi. N Nev.-Calif. line (1). ARIZONA. Mohave County: Fort Mojave (1); Mellon (1, probably migrant *cineraceus*). Yuma County: Cienega Spring, 5 mi. NE Parker (1, migrant?); Quartzite (1); 40 mi. S Quartzite (1); Yuma (1); 11 mi. SW Yuma (1). CALIFORNIA. San Bernardino County: Cedar Canyon, 5000–5300 ft., Providence Mountains (2, intermediates); 5 mi. N Earp (5). Riverside County: 25 mi. N Blythe (1); 8 mi. SW Wiley Well (1); Aztec Well (1); Shaver's Well (2); Cottonwood Springs (4). Imperial County: 2 mi. E Palo Verde (1); 20 [= 10 ±] mi. N Picacho (1); 4 mi. above [=north; also Sahuaro patch] Potholes (4); Potholes [also Laguna Dam] (3); Bard (7). BAJA CALIFORNIA. Type locality (see above; 1).

Yumanensis may extend north along the Colorado River above the open part of the valley of the Needles and Fort Mojave district but probably for no great distance, for

at the latitude of Las Vegas *cineraceus* is present in the mountains not far west of the river. The sample from the northern half of the known range of *yumanensis* is slightly less extreme in the development and proportion of pale-backed, yellowish and narrow striped variants than the group from near Yuma. A dark-colored winter-taken bird from Mellen probably is a migrant from the not distant range of *cineraceus*.

To the west of the Colorado River valley *yumanensis* apparently extends to the Imperial Valley area, to judge from the presence of typical specimens in the mountains bordering this valley on the north in Riverside County.

West of Cottonwood Springs in the Little San Bernardino Mountains of Riverside and San Bernardino counties a sparse population occurs in the piñon and scrub oak belt which is intermediate in color and size between *yumanensis* and *quercinus* of the coastal slopes. These fall in line with the wing-length cline (see fig. 1). In color they are variable, some being close to *yumanensis* and others as dark and coarsely striped as the grayer types of *quercinus*. None of the richly brown type of *quercinus* occurs. Several of these intermediates that are dark gray, fairly large, and broadly striped essentially duplicate *cineraceus* from the opposite side of the Colorado River. However, it seems fairly evident that the history of such birds is independent of *cineraceus* populations although they may have much the same set of genes and characters. They do not represent a type occurring across a broad area nor the terminal point in a cline but only a sector in a cline.

Apparently *O. a. clazus* Oberholser (1937), described from two specimens from the San Jacinto Mountains of Riverside County, is a similar stage in intermediacy along the western border of the deserts, or is even equal to the gray variants normal in *quercinus*. The latter situation is the most likely, since a bird from Palm Springs at the east base of Mount San Jacinto is a normal, moderately brown *quercinus* and another from the the same place is like the extreme gray variants of *quercinus*.

Otus asio inyoensis Grinnell

Otus asio inyoensis Grinnell, 1928*a*:213.

Type locality.—Independence, Inyo County, California (type in Mus. Vert. Zool.).

Range.—The Inyo region of California, principally Owens Valley, and the mountains west of Death Valley north to the Carson Sink area of Nevada; apparently extends across central Nevada to northwestern Utah (Oberholser, 1937:356; Behle, 1944:75).

Characters.—Size large, although no larger than *quercinus*. Coloration similar to *cineraceus* but background colors of underparts whiter and white areas about face and on legs more extensive. Shaft stripes of breast broad and boldly contrasted with white background, the cross bars more widely spaced and averaging slightly less numerous. Dorsal coloration usually more buffy or brownish gray.

Specimens examined.—Twenty-nine. NEVADA. Churchill County: 3 mi. N, 1 mi. E Fallon (2); 3-4 mi. WSW Fallon (7). Lyon County: 2 mi. ENE Dayton (1). CALIFORNIA. Inyo County: Roberts Ranch, Wyman Creek, White Mts., 8250 ft. (1 skel. only); 2 mi. N Bishop (1); 1½ mi. SW Big Pine [also Big Pine] (8); 5 mi. N Independence (1); Independence (2); Mazourka Canyon, Inyo Mts. (1); 1 mi. S Lee Pump, 6000 ft., Panamint Mts. (1); Walker Creek, 4 mi. SW Olancha (4).

The northern and northeastern limits of the range of *inyoensis* are but slightly known. A single bird from central Washoe County, Nevada, and birds from Cassia and Gooding counties, southern Idaho, in the collection of the Museum of Vertebrate Zoology are slightly darker about the head and more brownish on the back than *inyoensis* and have been identified as *macfarlanei*. However, they are much paler and grayer than many *macfarlanei* and may actually be nearer *inyoensis* than typical *macfarlanei*. The reported *inyoensis* from Utah may be of like nature. We have not at this time sought material to determine this.

In the Mohave Desert basin are great areas unrepresented by specimens and in which Screech Owls may actually be absent. Aside from *cineraceus* and *yumanensis* along the eastern edge of this basin and their intergrades in the Providence Mountains, we have material only from the coastal or western and southern borders of the Mohave Desert. Three specimens from the vicinity of Victorville are normal *quercinus*; a fourth is paler and less brown yet is not quite as gray as any of the intergrade group of the Little San Bernardino Mountains.

From the Tehachapi Mountains and Walker Pass areas, particularly the former, are good samples which are normal for *quercinus* and *inyoensis* in wing length (see fig. 1) and which show some approach to *inyoensis* in color. Four out of thirteen are close to *inyoensis* in reduced brown hues and general paleness, so much so that some or all would go undetected in a sample of *inyoensis* as darker extremes of that race. Such does not occur in populations of *quercinus* located on the Pacific drainages more remote from the desert divides.

Otus asio quercinus Grinnell

Otus asio quercinus Grinnell, 1915:60.

Otus asio clazus Oberholser, 1937:357.

Type locality.—Pasadena, Los Angeles County, California (type in Mus. Vert. Zool.).

Range.—Sacramento and San Joaquin valleys of California, below the continuous coniferous forest belts of the mountains and coast ranges, and coastal slopes from Monterey Bay south to latitude 31° in northwestern Baja California.

Characteristics.—Size large, as in *inyoensis* and the eastern populations of *cineraceus*. Coloration darker gray in background areas, above and below, than in *inyoensis* and brown hues much more prominent. At least narrow brownish areas always present beside shaft streaks of breast feathers and brown usually conspicuous in crural area. Shaft streaks broad as in *inyoensis*, and cross bars similar but less boldly contrasting with background gray than with the white of that form.

Specimens examined.—Forty-nine. Only those from coastal southern California and Baja California are here listed. No effort has been made to assemble all available material from southern California, as adequate samples were at hand for comparison with the desert races which have been our primary concern. CALIFORNIA. Kern County: ½ mi. W Summit Walker Pass (1); west slope Walker Pass, 4600 ft. (2). Los Angeles County: Sandberg, Liebre Mts. (10); Castaic (1); Calabasas (1); Toluca (1); Pasadena (10); Altadena (3); Mt. Wilson, San Gabriel Mts. (1); El Monte (2); Bassett (1); Claremont (3); 25 mi. W Hesperia (1). San Bernardino County: Mojave River, 6 mi. above Victorville (3); Hesperia (1). Riverside County: Riverside (1); near Corona (1); 10 mi. E Hemet (1); Palm Springs (2). San Diego County: Pine Mt. (1); Cuyamaca Mts. (1); Laguna Mt., 6000 ft. (1); 4 mi. S Barrett Lake, 900 ft. (1). BAJA CALIFORNIA. North end Nachogüero Valley, 3400 ft. (1); south end Valle de Las Palmas, 1200 ft. (1); Valle de la Trinidad (2); San Matias Pass (1); San Jose, 2500 ft., latitude 31° (1).

Intermediate group between *quercinus* and *yumanensis* in Little San Bernardino Mountains.—Ten. San Bernardino County: Black Rock Spring, 4500 ft. (1); Quail Spring, 3900–4500 ft. (3). Riverside County: 1 mi. W, 2½ mi. N Desert Hot Springs, Little Morongo Valley, 1500 ft. (1); Stubby Spring, 4750 ft. (1); 1 mi. E Key's View, 5000 ft. (1); Live Oak Tank (1); Pinyon Wells (2).

Quercinus shows a considerable range of color variation, some individuals being distinctly brown dorsally whereas others are gray, although not as purely gray as in the adjoining desert races. Especially gray-backed variants that apparently reflect intrusion of characters from grayish desert populations occur around the eastern or desert periphery of *quercinus* south of the Sierra Nevada.

The population in northwestern Baja California as a group is rather atypical; richly brown individuals are lacking, at least in the small sample available. Wing length diminishes in a gradient through this area toward *cardonensis* to the south.

Otus asio cardonensis Huey

Otus asio cardonensis Huey, 1926:360.

Type locality.—Canyon San Juan de Dios, about 10 miles east of El Rosario, Baja California, Mexico (type in coll. San Diego Soc. Nat. Hist.).

Range.—Baja California from latitude 30° 30′ on the west coast and latitude 31° on the east coast south to latitude 29°. May range considerably farther south, to latitude 28°.

Characters.—Wing short and size small, on the average slightly smaller than in *yumanensis* and equivalent to *sinaloensis*. Coloration darker, sootier gray dorsally than in *cineraceus* and lacking the brownish and buff hues of *quercinus*, even of the grayer extremes of *quercinus*. Ventral background color darker and shaft stripes and cross bars broader than in *xantusi* and *yumanensis*. Ventral cross barring prominent and close set. Crural area browner and more heavily marked than in *xantusi* and *yumanensis*.

Specimens examined.—Nine. BAJA CALIFORNIA. 6 mi. E El Rosario (8); El Cajon Canyon, 3200 ft., east base San Pedro Mártir Mts. (1 intermediate).

Cardonensis represents a level in the size cline running south through Baja California from both *quercinus* and *yumanensis* toward *xantusi*, but its color characters are not precisely intermediate. The dark, dull gray dorsal color is fully as dark as in *quercinus* but lacks the brown hue of *quercinus* and the buffy gray of *xantusi*. The dense ventral markings are not quite like those in either *quercinus* or *xantusi*. Probably the *cardonensis* type of coloration and stage in wing length prevails over a wide segment of middle Baja California, but between latitude 30° and the vicinity of San Ignacio, latitude 27° 17′, no specimens are available.

A bird from the east slope of the Sierra San Pedro Mártir is intermediate toward *yumanensis*, its color essentially duplicating that of *cineraceus* as Grinnell (1928*b*:116) indicated; but as in the case of the intermediates in the Little San Bernardino Mountains, this should not be taken to mean immediate derivation from, or population-affinity with, *cineraceus*.

Otus asio xantusi (Brewster)

Megascops xantusi Brewster, 1902:93.

Type locality.—Santa Anita, Baja California (type in Mus. Comp. Zool.).

Range.—Baja California from about latitude 27° 30′ south to the Cape.

Characters.—Smallest of all the races of *Otus asio*. Coloration paler, warmer gray above and whiter below than in *cardonensis* and crural areas less brownish; light areas of dorsal surface usually yellowish. Shaft streaks narrow as in *yumanensis*, the lateral bars similar. Color similar to *yumanensis*, but less extremely white below and darker, warmer gray above.

Specimens examined.—Twenty-eight. BAJA CALIFORNIA. San Ignacio, 400 ft. (1); Campo Los Angeles (1); La Paz (1); Laguna Valley, 6000 ft., Victoria Mts. [also called Sierra de Laguna Mts.] (2); Agua Caliente, 800 ft. (5); Miraflores, 600 ft. (18).

Although *xantusi* has been compared with *sinaloensis* by Moore and Peters (1939: 42) in a way that would suggest close affinity, this may be misleading. *Sinaloensis* is darker on the legs and in the gray of the underparts and has even narrower ventral shaft streaks coupled with dense lateral cross bars, which gives a reticulate effect. The small size in which the two forms are alike is best regarded as a parallelism, under the influence of the Bergmann principle, rather than as a sign of immediate common derivation. Probably *xantusi* is a geographic modification of a northern stock. Actually it is close to *yumanensis* in most features, between which the darker *cardonensis* intervenes.

Otus asio sinaloensis Moore

Otus asio sinaloensis Moore, 1937:64 (type in coll. R. T. Moore).

Type locality.—Guamuchil, 45 feet, northwestern Sinaloa, México.

Range.—Southern Sonora from about latitude 28° southward and coastal plains and foothills of northwestern Sinaloa.

Characters.—Differs from *cineraceus* in darker gray coloration dorsally, less pure white ventrally, and in frequent tawny washes (vinaceous effect) and brown and tawny areas bordering shaft streaks; shaft streaks finer, contrasting less with dense, though fine cross bars of ventral feathering. Crural areas heavily marked and rich brown. Toes bristled to greater extent than in *cineraceus* with consequent reduction in normal feathering. Wing length slightly less than in neighboring *cineraceus* of northern Sonora.

Specimens examined.—Fourteen. SONORA. 10 mi. N Guaymas (2 intermediates); 3 mi. N Empalme (1 intermediate); 15-17 mi. NE San Bernardo, 2000 ft. [Los Algodones] (4); 10 mi. N Alamos (2); 5 mi. N Alamos (1); Alamos (1); Guirocoba (2); Agiabampo (1).

For discussion of intergradation with *cineraceus* in the Guaymas area of central Sonora, see p. 172. Moore (1941) has described a situation in Jalisco and Michoacán which suggests that the *sinaloensis-vinaceus* group of races of Screech Owls occurs in the same general region where a series of *cineraceus*-like races is present. This situation is still imperfectly known, but even if two chains of races here react as species, one should not lose sight of the fact that in Sonora a gradual intergradation of *cineraceus* and *sinaloensis* occurs in which the proportion of dark colored, finely streaked types increases progressively southward. This is the type of racial intergradation found between many races of Screech Owls. There may then be overlapping of races without interbreeding in southwestern México, but these end groups are certainly connected in the north as normally intergrading units and the whole complex should therefore be treated as one species.

SUMMARY

Screech Owls (*Otus asio*) are abundant and successful nocturnal raptors in the desert areas of western North America. They feed chiefly on large ground-dwelling arthropods.

A large group of specimens has been assembled by persistent nocturnal hunting in which advantage is taken of aggressive response of the owls to imitated calls. The series of skins reveals a wide amplitude of individual variation, appreciation of which justifies synonymizing certain races that have been proposed. Eight races are recognized in or bordering the lower Colorado River basin and the Gulf of California, one of which requires renaming.

A conspicuous difference in size, in the order of forty per cent, exists between the smallest and the largest owls of the desert areas. The clines in wing length, reflecting size in considerable degree, conform with Bergmann's principle, the smaller dimensions occurring in the warmer areas to the southward and at low elevations. Nocturnal habits and the cold winter nights at higher elevations in the north pose special problems of heat conservation for this non-migratory species. Large size, with a more favorable surface-mass ratio, appears to have definite selective advantage in the more northern and montane populations.

Clines in the general aspect of coloration coincide with environmental background colors and patterns and apparently contribute importantly to concealment. Concealment in these moderately small and easily captured owls is elaborately furthered by special posture and by the extreme elevation of ear tufts in addition to coloration.

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Museum of Vertebrate Zoology, Berkeley, and Department of Zoology, Los Angeles, University of California, December 26, 1950.

RELATIONSHIPS BETWEEN BIRDS AND DEER

By THANE RINEY

The purpose of this paper is to discuss the relationships that exist between birds and the mule deer (*Odocoileus hemionus*). From July, 1947, until January, 1950, I had the good fortune to live with a population of migratory deer in the central Sierra Nevada of California between Yosemite National Park and the Sonora Pass Road. This population, wintering on Jawbone Ridge, is known as the Jawbone herd. Most of the field observations mentioned were made within the yearly range of this group of deer. For critical reading of the manuscript I am indebted to S. B. Benson, A. S. Leopold, and A. H. Miller. The work was conducted under the auspices of Pittman-Robertson Project 28–R.

INFLUENCES OF DEER ON BIRDS

Prey-predator relations.—The Golden Eagle (*Aquila chrysaëtos*) is the only bird in the vicinity of the Jawbone population known to prey on deer. One incident should make this relationship clear. Mr. V. Burandt, a trapper, was quail hunting with a companion on the ridge adjacent to the Jawbone study area on November 2, 1948. Both heard a whistling sound and saw an eagle descend in a steep dive to grasp a fawn five to six months old, sinking its talons into the fawn's back. After the trapper fired at it, the eagle released its hold on the fawn and rose circling over the area. In less than 15 minutes they saw it dive again and strike the fawn, knocking it over a cliff. Mr. Burandt fired a second time at the bird which again rose and circled. Inspection of the fawn revealed a freshly broken left hind leg and the two men decided to leave it for the eagle. As they left the area, the eagle was seen again diving toward the spot where they had left the crippled fawn.

Published records of eagles preying on deer are not numerous but serve further to define the character of this relationship. For example, attacks on fawns by eagles have been reported by Boyer (1948), Clawson (1948) and McLean (1925) in California, and by Brown and Couey (MS, 1950) and Couey (1944) in Montana. In a current study of several pairs of nesting Golden Eagles in Santa Clara and Alameda counties, California, Mr. S. Kent Carnie (unpublished data) found that in only one nest out of ten which he examined, did fawn remains constitute a prominent part of the food brought to the nestlings. In this area, Carnie concludes that only occasionally does an eagle learn the trick of catching fawns.

Observations of eagles attacking adult deer have been made in Montana (Brown and Couey, MS, 1950), and in the Teton Mountains near Moose, Wyoming, by Frank and John Craighead (letter dated June 2, 1950). Both Boyer (1948) and the Craigheads have witnessed adult deer standing on their hind feet and striking at attacking eagles.

In the winter of 1948-1949, at least 30 per cent of the Jawbone population was calculated to have died from starvation or from causes related to malnutrition. About half of these dead deer were fawns. Any factor which continues operating to reduce numbers of deer in overpopulated deer range is of long term value to the range as well as to the deer population. The eagle thus performs a small service.

Carrion feeders.—Golden Eagles, Bald Eagles (*Haliaeetus leucocephalus*), and Red-tailed Hawks (*Buteo jamaicensis*) have been observed feeding on deer carcasses on the Jawbone winter range. A Swainson Hawk (*Buteo swainsoni*) was seen leaving the vicinity of a carcass on which it was thought to have been feeding. Turkey Vultures (*Cathartes aura*) have been seen feeding on deer carcasses on the summer range. Deer constitute one of the favorite foods of the California Condor (*Gymnogyps californianus*) but the

carcasses are utilized infrequently, for they commonly occur in canyon bottoms or in brush, sites difficult for condors to reach (Carl Koford, letter, January 11, 1951). According to Koford, deer are rated below squirrels and domestic stock in importance as food items for condors under present conditions. Koford once observed 28 condors feed on a deer carcass; they cleaned it up in about one-half hour, after having been kept from the carcass for several hours by Golden Eagles.

Birds often reach the carcass very soon after the deer dies. For example, on November 14, 1949, a Golden Eagle was seen feeding on an illegally-taken buck which must have been freshly killed, for it was still warm and blood was dripping from a bullet wound in the neck.

Carrion feeding, then, is one way in which certain birds profit by the presence of dead deer.

Deer hair as nest material.—The nest collection of the Museum of Vertebrate Zoology was examined to learn if birds used deer hair as nesting material. The total number of nests examined was 794. Six hundred and twenty-two nests (78 per cent) contained some kind of hair and of these only 13 (2 per cent) contained deer hair. Nests of 46 species contained hair of some kind and 11 of the 46 species used deer hair in some part of the nest, usually the lining. Data on kinds of nests which contained deer hair are shown in table 1.

Table 1

Species Using Deer Hair in Nest Construction

Species	Number nests examined	Number nests with deer hair
Gray Flycatcher (*Empidonax griseus*)	5	1
Western Flycatcher (*Empidonax difficilis*)	11	1
Bush-tit (*Psaltriparus minimus*)	20	1
Hermit Thrush (*Hylocichla guttata*)	10	2
Swainson Thrush (*Hylocichla ustulata*)	14	1
Hermit Warbler (*Dendroica occidentalis*)	1	1
Pileolated Warbler (*Wilsonia pusilla*)	4	1
Lazuli Bunting (*Passerina amoena*)	7	1
Junco sp.	21	2
White-crowned Sparrow (*Zonotrichia leucophrys*)	24	1
Fox Sparrow (*Passerella iliaca*)	15	1

This collection of nests probably shows a smaller proportional use of deer hair than would be expected in a collection of nests taken exclusively from environments removed from urban influences. This nest sample is weighted to some undetermined extent in favor of nests picked up in the vicinity of towns.

Birds feeding on ectoparasites of deer.—I have seen Scrub Jays (*Aphelocoma coerulescens*) standing, walking, and picking at the backs of deer in Tuolumne County, California. This relationship has been noted by Richard Taber in Lake County, California, and by Raymond Dasmann, in Sequoia National Park. The following observation was extracted from Taber's field notes of January 25, 1950, and is typical. "Jay flies to rump, hops to head, bends over as if pecking or searching. Flies back to rump, then hops to base of neck, searches and thence to head. Stays there, bending over one minute then flies off. All this time the deer has not changed position or even flicked ears."

I have observed jays on bedded does and on standing does and, whenever they have been watched for any length of time, they have been seen to pick at the back of the deer as if for ectoparasites.

Yellow-billed Magpies (*Pica nuttallii*) have, on several occasions, been seen walking on bedded or standing deer and picking at the backs of the deer. Deer have remained undisturbed during these observations and apparently tolerate this behavior of magpies as they do the actions of the jays. Mr. Robert Lassen reports similar relations existing between Black-billed Magpies (*Pica pica*) and mule deer near Doyle, in Lassen County, California.

Deer as temporary resting sites.—Mr. Raymond Dasmann observed a Scrub Jay perched, in a sleeping position, on a doe's back in Sequoia National Park on January 27, 1950 (oral communication).

I observed a Black Phoebe (*Sayornis nigricans*) rest momentarily on the back of a bedded doe, fly out and up in a short flight after an insect, then perch on a nearby oak branch.

These two observations serve further to emphasize the mutual toleration of birds and deer. Such occurrences are probably common and are doubtless observed far more often than they are recorded.

COMPETITION FOR FOOD BETWEEN BIRDS AND DEER

Deer are so highly adaptable in their food habits that, in my opinion, competition with birds in the Jawbone area is unimportant, for, while preferences may overlap, the conflict is usually so slight that neither birds nor deer suffers from lack of food by the presence of the other. However slight and insignificant such competition eventually proves to be, it does exist and may be more important in other areas.

Mexican Bluebirds (*Sialia mexicana*) and mule deer have been seen eating the berries of the hairy mistletoe (*Phoradendron villosum*) on the Jawbone winter range. The eating of mistletoe by deer, however, is largely confined to cleaning up bits that drop to the ground from storm-blown trees, except in favorable circumstances where they can reach low growing plants from the ground. The bluebirds concentrate mainly on the berries, whereas deer eat all but the hardest woody parts.

In summer and fall deer sometimes compete with jays, magpies, Band-tailed Pigeons (*Columba fasciata*), Acorn Woodpeckers (*Balanosphyra formicivora*) and Gray Squirrels (*Sciurus griseus*) for acorns. On one occasion a doe was seen to lower its head and walk rapidly toward a Scrub Jay, chasing it from beneath a California black oak (*Quercus kelloggii*) into the under branches of a neighboring oak. When first seen, both animals were feeding on acorns under the same tree.

Marked year to year variations in abundance of acorns will doubtless modify the character and importance of competition for acorns between birds and deer.

Influences of birds on deer disturbances.—All the senses of deer, with the possible exception of taste, are important in keeping them in touch with other animals in their surroundings and in warning them of environmental disturbances. My observations are restricted in this paper to those involving the sense of hearing. It should be recognized that the other senses of deer play important and often parallel roles.

Deer react to two main types of environmental disturbance involving birds: bird sounds which indicate a sudden change in the birds' activities and zones of silence in disturbed areas. Sounds such as the whirr of quail or grouse wings, the vigorous scolding of jays or the excited and erratic "thup" notes of the Oregon Junco (*Junco oreganus*) elicit alarm reactions in deer. Equally important in warning deer are the absences of bird sounds, or zones of silence that often surround intruders as they penetrate a previously undisturbed environment. Silence results because the alarmed birds seek shelter and become inactive.

Reactions of deer to disturbance vary from mild curiosity to headlong flight and

vary among individuals, being different for the sexes, for various age groups and at different seasons. As a general rule, the more sudden and greater the disturbance, the quicker and stronger the reaction. But if a deer or group of deer has already been alerted by some disturbance, then the slightest sound or movement is apt to cause flight.

I have on several occasions tested a deer's hearing. In one instance, a doe had been watched for several minutes and was completely undisturbed. I was concealed with another observer 50 yards down wind from her and inside the edge of a fir thicket. One finger nail was clicked against another. Instantly the deer alerted. I waited until she resumed grazing and clicked again, and again her head snapped up in an alert position. Clicking was continued at intervals for about 10 minutes until the doe finally became so agitated she circled around us, picked up our scent about 50 yards down wind, and then bounded off.

Frequency of bird-deer contacts.—In the past four years, I have observed more than one hundred incidents in which a bird by reacting normally to some disturbance with an alarm note or a sudden flight was incidentally responsible for either alerting the deer or causing it to leave the disturbed area. It is natural that in observations of this type most of the incidents encountered are incompletely understood. But it seems apparent that bird-deer contacts frequently occur as a normal part of a deer's life. It follows that birds, as part of a deer's organic environment, are extremely important in keeping deer in touch with local disturbances. In the Jawbone study area, I have observed coyotes, bears, bobcats and man alarm birds which in turn alerted deer to the disturbing influence. In most of the instances observed, the deer eventually became aware of the predator involved. However, many incidents of birds alerting deer were seen where the cause of the disturbance remained unknown.

Man. Examples of man-caused disturbances are commonplace to hunters and naturalists; therefore only one example is cited here. In September, 1949, a Steller Jay (*Cyanocitta stelleri*), disturbed by a member of the deer study crew, called loudly, causing a doe and fawn to cease feeding in a meadow and to trot out of sight into pine cover. This incident was observed and recorded by another member of the deer study crew, from a distance of several hundred yards. During the hunting season it was common to make several observations of this type each day.

Coyote. In the winter of 1948, Spotted Towhees (*Pipilo maculatus*) were seen flushing about 30 feet ahead of a coyote (*Canis latrans*) and flying to the tops of nearby manzanita bushes. I followed the progress of the coyote by watching the birds. A wave of disturbance accompanied the coyote in this instance, followed by a zone of silence, the result of the birds' remaining quiet in the shrubs. In this case, it was ten minutes before the birds resumed their normal activities.

In the summer of 1949, on the Jawbone herd summer range, a doe was alerted by a sudden call of a Red-shafted Flicker (*Colaptes cafer*) followed by several alarm notes of the Robin (*Turdus migratorius*). In less than a minute, I saw a coyote trot out of the timber from which the birds had called and continue along a trail across a clearing. The doe stood without moving near the crest of a small ridge which was between her and the coyote. As she watched the predator, only a portion of her head was visible, for she was almost hidden from the coyote by a large boulder on the ridge. As the coyote passed the deer and moved down trail the doe followed along the ridge, keeping the coyote in sight for at least another 100 yards before both animals were lost to my sight. Although the coyote was apparently not interested in this deer, nevertheless, a Red-shafted Flicker and at least two Robins clearly alerted the doe to the presence of the coyote.

Bear. Although many encounters have been seen between bears (*Ursus americanus*)

and deer and several incidents of birds warning bears of the approach of humans have been recorded, I have only one recorded incident involving birds, bears and deer. This incident took place on June 24, 1949, at 5:50 a.m., on a hillside that at that time had been under continuous observation (by two shifts of observers) for two days and two nights. This area had in no way been altered by human activity.

For over 45 minutes a bear was active foraging across the observation area. During this period we kept track of its progress by noting the actions of the Steller Jays and deer. Does would trot out of the aspen patch in which the bear was moving and stand facing the aspens snorting and stamping their front feet, behavior any mule deer is apt to exhibit while in a state of excitement. The deer could easily hear the bear as it moved through the aspen patch with its understory of broken twigs, and the calling of the jays from distances of from 25 to 50 yards of the bear only added to the general disturbance on the whole hillside. Alarm notes of Robins, Red-shafted Flickers, and the scolding of Steller Jays were heard for another five or ten minutes after the bear had left our study area and after the immediate hillside had returned to a relatively undisturbed state.

If learning plays a role in this bird-deer relation, such incidents probably provide a strong conditioning stimulus for deer.

Bobcat. The normal reaction of adult does to bobcats (*Lynx rufus*) is to chase them. For example, on Jawbone ridge, in the spring of 1949, a doe was alerted by the calling of Steller Jays. Looking quickly in the direction of the jay calls, she located a large bobcat walking slowly across a hillside clearing about 100 yards distant. The doe then turned and trotted stiff-legged toward the bobcat and, as the cat found itself detected and started running, the doe increased her speed and chased the bobcat out of the clearing, a distance of another hundred yards. I have seen variations of this same reaction over a dozen times both in the Jawbone area and in the coast ranges of California.

Although these incidents have been observed at all seasons of the year, the urge to chase cats seems particularly strong during the period when the fawns are young. In the Jawbone area this coincides with the nesting and fledging seasons of birds.

Bird sounds responsible for return to normal behavior.—Familiar to most naturalists are the sudden hushes that spread around us when we exceed even by a slight margin a certain permissible carelessness as we walk into an area. Similar responses are often started by animals other than man. For example, in November, 1947, a Scrub Jay calling loudly in response to an unknown disturbance caused about 20 migrating Hermit Thrushes (*Hylocichla guttata*) in the vicinity of a watering hole to quiet down for 20 minutes. In December, 1948, Spotted Towhees and Fox Sparrows (*Passerella iliaca*) were observed leaving the ground and "freezing" in the upper parts of a manzanita thicket as a coyote trotted along a trail through the manzanita. The duration of such silences can sometimes be shortened by imitating some appropriate bird note. Often this imitation does not have to be accurate to be effective.

I have frequently observed some normal bird behavior provide the stimulus that permitted a deer to abandon an alert attitude and resume its undisturbed activity. For example, in December, 1949, an adult doe accompanied by a fawn was grazing in the center of a small clearing. The attention of the doe was directed suddenly toward one edge of the clearing. She held her head high, with ears pointed forward and took two or three hesitant steps forward. At this time six Oregon Juncos left a manzanita at the clearing's edge, flew about ten feet into the clearing toward the doe and started feeding. Almost as soon as the juncos reached the ground, the doe flicked her ears, partly turned, scratched behind one ear with her hind foot, and resumed feeding.

This type of observation seems to be a good example of a return to normal behavior by deer stimulated by normal bird behavior. However, on some occasions, such examples

are not complete enough to make one certain that birds are the key stimulus for the deer's return to an undisturbed condition.

The best evidence I have in this connection is the fact that, under certain conditions, I have been able to induce deer to resume their normal behavior by imitating bird calls. This is especially effective when deer have been alerted by some sudden sound or movement and have stopped in an alert position, uncertain whether to take flight or to resume undisturbed activity.

An interesting example of this took place in the course of the 1948 fall migration of deer about three miles above the upper limits of the winter range. I had disturbed a small group of deer and in working slowly up one of the main migration trails re-located two of them, a fawn and yearling, standing inside the edge of a fir thicket and about 50 feet up trail from me. I was fully exposed and the deer were in plain sight of me but were facing in another direction. At my first imitation of a sparrow note the deer turned, stepped into the trail and continued walking to within about two feet of me before the fawn, which led, suddenly noticed me and both deer bounded off out of my sight.

In the spring of 1950, on the Jawbone winter range, I demonstrated this aspect of deer behavior to Mr. Archie Mossman. We stalked to within 75 yards of a group of 18 deer without their being aware of our presence. My plan was to alert them deliberately to induce them to return to undisturbed behavior by imitating the song of the Western Meadowlark (*Sturnella neglecta*), a bird absent from the ridge during the winter and which had returned to this clearing only during the previous week. The following quotations are taken from Mossman's field notes for April 16:

"About one half hour after the sun must have reached into a small gully, we moved into the area, without disturbing the numerous deer that were grazing and bedded there. In order to test the effect of familiar bird notes . . . on alerted deer, I watched with 8×24 glasses a deer lying down and several others grazing, all in the field of view at the same time. The bedded deer was close enough so I could see it chewing its cud . . . . Riney then slowly whistled Yankee Doodle to disturb the deer. The grazing deer immediately raised their heads and looked at us, and the lying deer looked, lowered its neck and head about eight inches, stopped chewing its cud and looked about ready to jump to its feet. Then Riney gave the song of the Western Meadowlark, and within 5 to 10 seconds, the other deer were grazing again, the ears of the bedded deer were directed away from us, and it turned its head and started chewing its cud again. Similar experiments [gave] . . . the same results. I'm pretty well convinced of the reliance of deer on bird noises, song in this case, for information about danger."

For certain aspects of our deer work when we were concentrating on observing deer in an undisturbed condition, this trick of imitating normal bird notes was often useful in shortening the time we had to wait for the environment to return to an undisturbed condition after we had disturbed some part of it by entering

Is the reaction of deer to sudden changes in normal bird sounds a learned one or is it inherited? I do not know. Because small fawns react in the same manner as adults to bird disturbance, one might be tempted to favor the notion that this type of community reaction is an inherited thing built up from long association with similar past species associations. On the other hand, because of observations such as the bear-bird-deer incident described earlier, it seems probable that learning enters into the picture to at least some extent. Before conclusions can be reached, more work needs to be done along these lines and should include the testing of experimental animals under conditions more accurately understood than those which obtain in the field.

Movements due to accidental disturbance by birds.—Many movements of deer are due to sudden disturbances by birds and are made incidentally to the normal bird activities, without the apparent presence of predators. Four examples are cited to illustrate the variable character of this accidental relation.

At 5:30 a.m., in September on the summer range, a spike buck was walking slowly up hill, feeding, apparently alone. As it passed under a large aspen a female Cooper Hawk (*Accipiter cooperii*) suddenly flew from a branch 10 feet above the buck, struck a few aspen leaves with its wings as it left, and startled the deer so that it immediately jumped ahead and bounded about three times before reaching the edge of the clearing where it disappeared.

In October, 1948, 50 Band-tailed Pigeons left a black oak and neighboring white fir (*Abies concolor*) on which they had been perched and, in leaving, startled at least two deer which bounded away for a distance of about 25 yards before I lost track of them.

On several occasions, I have observed short deer movements caused by a sudden nearby flight of Mountain Quail (*Oreortyx picta*).

The sudden whirring sound made by the wings of a flock of about 50 Robins startled 20 deer which ran about 50 yards and out of the sight of Bernice Riney, who was observing from a tree-top on the Jawbone winter range in November, 1949.

By means of an elaborate three-year live-trapping and tagging program, it was learned that the winter home range of an individual deer of the Jawbone herd was extremely small. The radius of activity for does and fawns measured about 200 yards; bucks had a radius of about 500 yards (Leopold, Riney, McCain, Tevis, 1951). In this area the fact that the home ranges are restricted, and, further, that the food on these ranges is critical in moderate to severe winters, makes an even distribution of deer in available feeding areas an important consideration for the welfare of the deer. Birds, through the cumulative effect of these accidental disturbances as well as the predator stimulated disturbances, are useful in instigating a measure of movement of the deer within their home ranges. If this results in even a little better distribution of deer feeding activities it is advantageous to the deer population.

DISCUSSION AND SUMMARY

Bird activities are in various ways influenced by deer especially in the early summer, fall and winter. Eagles occasionally learn to prey on fawns and have been known to attack adult deer. Vultures and hawks commonly feed on road-killed deer and on those crippled in the hunting season. In the Sierra Nevada, winter is the time of year that the greatest number of deaths normally occurs in the deer population. Hawks and eagles are quick to take advantage of many of the carcasses.

In the spring and summer, birds of several species use the hair of deer as nesting material.

Birds have been seen picking at the backs of deer apparently for ectoparasites. They also perch on the backs of deer and forage out after insects in the vicinity of the deer.

These observations show that the presence of deer, dead or alive, is of a beneficial nature to many birds.

Birds have been observed alerting deer to the presence of man, coyotes, bears and bobcats. On the Jawbone ridge area of the Sierra Nevada two seasons assume special significance, first, the fawning season of the early summer months, and second, the fall hunting season.

Bird sounds are often responsible for a deer returning from a disturbed to an undisturbed state. This relationship involves a recognition by the deer of zones of silence due to sudden disturbance, and the further recognition of the resumption of sounds associated with undisturbed bird activities. Understanding of this relationship was considerably facilitated by imitating bird notes which, under the proper conditions, were successful in inducing deer to abandon attitudes of alertness.

Accidental disturbances of deer by birds are believed to contribute to the daily dis-

tribution of mule deer within their individual home ranges; and to be a factor operating in combination with the influence of predators in helping toward a wider utilization of deer forage within a given individual deer's winter range.

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THE SEASONAL OCCURRENCE OF SHOREBIRDS ON BAY FARM ISLAND, ALAMEDA COUNTY, CALIFORNIA

By ROBERT W. STORER

The mud flats on the north and west parts of Bay Farm Island, Alameda County, California, are known as one of the major shorebird concentration areas in the San Francisco Bay region; and, although the island has been visited frequently by ornithologists, to date no one has published an account of the seasonal variation in abundance of the shorebirds there. For this reason the shorebirds on these parts of Bay Farm Island were censused for a year beginning July 1, 1948.

In order to learn something about the habitat preferences of the species of shorebirds involved, the area suitable to shorebirds was divided into ten parts and the numbers of birds found on each sub-area (fig. 1) were recorded on mimeographed census sheets. Some of these sub-areas were found to attract few or no shorebirds and consequently were seldom visited.

The most important feeding area (B) was a large mud flat surrounded by dikes on the north and west, by Maitland Drive on the east, and by Island Road (also known as Mecartney Road) on the south. Until 1940 this area was farm land, but at the time of the census all except the south edge, which supported a salt marsh flora with *Salicornia* predominating, lay between the zero and five-foot tide levels. At the south side of B there was an artificial sand bar (F) with a small pond on its south side. The bar remained uncovered during all but the highest high tides and was sometimes used as a loafing area by gulls, terns, and shorebirds.

The second most important feeding area for shorebirds on the island included the mud flats (A) of San Leandro Bay, from the Bay Farm Island Bridge east to a point north of the pond (J), a distance of approximately one mile. This area was bordered on the south by a band of salt marsh of which *Spartina* and *Salicornia* were the dominant plants. There was a chain of islands covered with similar vegetation on the northeastern part of this area. These marshy areas were used as loafing grounds by some of the larger species of shorebirds. The mud flats of the southeast side of the Island of Alameda lay across a narrow channel from A, and there was some interchange of feeding shorebirds between these two areas.

At the northeast corner of the junction of the bridge with Bay Farm Island, there was a small sandy area (C). The sand was mixed with stones, and during part of the year a growth of green algae covered much of the area, thereby changing its character considerably. Across the road from C was a dike (L) which was largely gravel overlying mud. Beyond the inlet at the west end of L a similar section of dike had been cut off from the rest of the dike and served as a roosting and loafing area for many birds, particularly gulls and terns.

The water level in the sandy-clay bordered pond (J) varied little, and this pond proved to be a favored place for Greater Yellow-legs, Northern Phalaropes, and Killdeer, which tended to remain there throughout the day regardless of the conditions on the mud flats. The pond was also regularly visited by flocks of Dowitchers and Avocets on their way to or from their feeding grounds. The pond (K) at the edge of the Alameda Dump was filled with and bordered by tin cans and bottles. An occasional Killdeer, Yellow-legs, or Snipe was seen there. Three small, cattail-bordered ponds (G, H, and I) on the golf course were apparently not suited for use by shorebirds.

The south and west shores of Bay Farm Island were bordered by intertidal areas of fine sand mixed with mud. These were occasionally visited at D and E, but there were never many shorebirds feeding there.

Censuses regularly covered the areas A, B, C, F, J, and L, although the last could not always be counted because of the presence of fishermen. A total of 39 counts was made between July 1, 1948, and June 30, 1949. These counts were distributed by months as follows: July, 5; August, 5; September, 5; October, 2; November, 3; December, none; January, 3; February, 2; March, 2; April, 2; May, 5; and June, 5. Of these counts, 30 were made by the writer, 7 (including all the June counts) were made by Mrs. Junea W. Kelly, and one each by Howard L. Cogswell and Galen Smith. Numerous

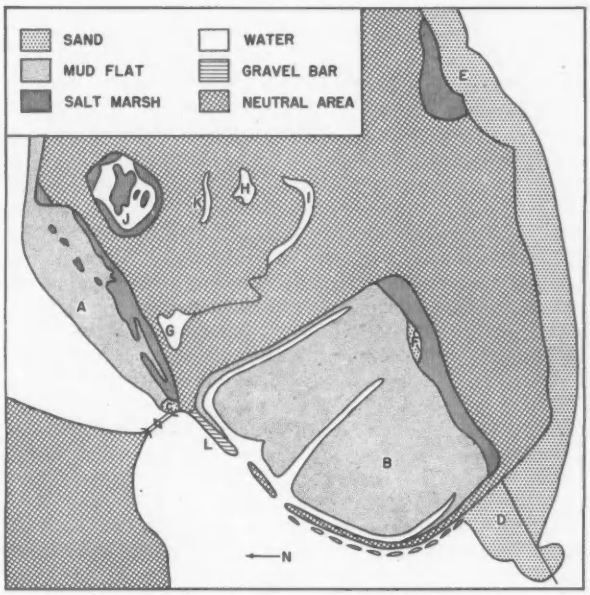

Fig. 1. Map of western end of Bay Farm Island, Alameda County, California, showing areas covered in census of shorebirds. Part of the island of Alameda shows in lower left corner.

others accompanied the writer on one or more occasions and assisted in making the counts. These included S. T. Bailey, Mrs. H. C. Austin, H. Bern, K. L. Dixon, W. Fox, G. Gullion, R. McCormick, A. H. Miller, F. A. Pitelka, T. A. Riney, and L. O. Williams. I am particularly indebted to Mrs. Kelly for much additional assistance—numerous partial censuses, field notes from other years, and helpful criticism based on her extensive knowledge of the area and its shorebirds.

On Bay Farm Island, most of the shorebirds fed during ebb tide. As the upper fringe of the mud flats became exposed, the birds arrived and began feeding. As the water receded, the birds followed, maintaining their general relation to the water's edge. Western Sandpipers, Willets, and Black-bellied Plovers tended to feed on the exposed mud; Red-backed Sandpipers and Dowitchers, in the shallow water; and Marbled Godwits and Avocets, in the deeper water. As the tide reached its lowest ebb and the birds had obtained sufficient food, there was often a period during which the birds flew about in

groups over the mud flats, alighting here and there for short periods before moving off to the loafing grounds to await the next ebb tide.

Most of the larger shorebirds, including Avocets, Marbled Godwits, Willets, and Dowitchers, spent the periods between ebb tides in the marshes to the east of Bay Farm Island, although some individuals used the marshy islands northeast of A for loafing. The Western Sandpipers seemed to prefer more open loafing grounds and were most often to be found on the sand bar at F during the flood tides. During the highest high tides, this bar was covered. At these times, as well as at other times when no cause could be ascertained, the Western Sandpipers roosted on the caked mud northwest of the pond (J) or, more frequently, at undetermined places off the island. (Shortly after the census period, Mrs. Kelly found thousands of sandpipers loafing on the dikes and flat surfaces of the old ships on the west end of B.)

Fig. 2. Seasonal fluctuations in the abundance of the Western Sandpiper and of all shorebirds on Bay Farm Island, July 1, 1948, to June 30, 1949. The dashed lines indicate the numbers of Western Sandpipers based on estimates of the percentage of this species of the total number of small shorebirds.

When returning to the mud flats to feed, the shorebirds, especially the larger species, flew west over the estuary between Alameda and Bay Farm Island, and observers posted on the south end of the bridge across the estuary could at times observe spectacular flights. Occasionally, the flights of Avocets began before the tide had ebbed sufficiently to permit the birds to feed, and hundreds of Avocets waited, massed on the island north of B, until the tidal conditions were right for feeding. This island was occasionally used as a loafing area by the Avocets.

Several factors appeared to influence the time of feeding and the numbers of birds present. In the first place, variation in the height of the high and low tides was important. In the San Francisco Bay area, the differences in height between the two high tides and the two low tides of a given lunar day vary cyclically. The difference between the two low tides may reach four and one-half feet, and that between the two high tides, two feet. A period of tidal extremes occurs once during each lunar month and is suc-

ceeded by a period during which the two daily tidal cycles approach equality, after which the differences increase until the extremes are again reached. The lowness of a given low tide determines the extent of the intertidal zone exposed and the length of time during which the birds can feed. Since the birds follow the receding water-line, it will be seen that it was desirable to make counts when tidal conditions were such that the maximum numbers of shorebirds were feeding and before the birds got too far from the high tide mark for ready identification. These conditions were met when the tide was one-third to one-half ebbed.

The water level is not, however, entirely dependent upon the tides. Strong winds tend to pile up the water on the east side of San Francisco Bay, and this raises the water level at Bay Farm Island to a considerable extent, flooding areas normally dry and delaying the uncovering of the mud flats. This makes it necessary for some birds to shift their loafing grounds and both shortens and delays the birds' feeding periods.

Bay Farm Island is a popular duck-hunting and fishing area, and, consequently, there is considerable disturbance to shorebirds by man. In 1948, the hunting season was divided, one-half occurring in October, and one-half in December. On October 31, when many duck hunters were present on B and L, very few large shorebirds were to be found on the island, although numbers of the smaller species were apparently little affected. The gravel dike (L) is a favorite place for fishing, and on several trips this area had no shorebirds on it for this reason. In view of the popularity of the area among sportsmen, censuses were conducted, when possible, on weekdays.

The seasonal fluctuations in numbers of shorebirds on Bay Farm Island are shown in figure 2. Southbound migrants began to arrive in late June and built up to a peak in numbers in August and September when from fourteen to sixteen species and from seven to thirteen thousand individuals were present. (The low count of 3,639 birds on August 18 was made when tidal conditions were unfavorable.) The higher peak in November reflects the arrival of wintering species such as the Red-backed Sandpiper and the Avocet before the primarily transient species had left. From November until late February there appeared to be a steady decline in numbers. The low count on March 12 was due to the departure of most of the wintering Avocets. From this date, the numbers of spring migrants rose rapidly until April 23 when an estimated 41,900 individuals of seventeen species were present. Following this peak, the numbers of birds declined to the yearly low of one to two hundred birds of six to seven species in late May and early June. The extended season of the fall migration as contrasted with the brief period of the spring migration and the consequently greater numbers of individuals present at the peak of the spring flight is similar to the pattern of migration of shorebirds on the New Jersey coast (Urner and Storer, Auk, 66, 1949:177-194) and, in general, to those of most species of highly migratory birds.

In the year covered by this census, twenty-three species of shorebirds were observed on the study area. These, listed in order of their abundance based on a combination of maximum numbers observed and frequency of occurrence, were:

Abundant or very common

1. Western Sandpiper
2. Short-billed Dowitcher
3. Avocet
4. Willet
5. Marbled Godwit
6. Black-bellied Plover
7. Red-backed Sandpiper

Common

8. Least Sandpiper
9. Semipalmated Plover
10. Killdeer
11. Sanderling
12. Greater Yellow-legs
13. Hudsonian Curlew

Uncommon to rare

14. Northern Phalarope
15. Black Turnstone
16. Knot
17. Red Phalarope
18. Ruddy Turnstone
19. Wilson Snipe
20. Long-billed Curlew

Very rare

21. Snowy Plover
22. Golden Plover
23. Spotted Sandpiper

It should be emphasized that these expressions of abundance refer to the study area only. Many of these species are more numerous in other parts of the San Francisco Bay area. For instance, both species of phalaropes are abundant in migration off the coast, Sanderlings and Snowy Plovers are very common on the outer-beaches, and Black Turnstones are common on the rocky parts of the coast. An annotated list of the species observed follows.

Squatarola squatarola. Black-bellied Plover. Common from late July to late April (see fig. 3). A few were present in late June and early July of 1948, but none was seen between May 21 and July 1 of 1949. The main fall flight took place during the first half of September, and the principal spring flight occurred in April. The largest number recorded was 992 on February 12 and probably represents a concentration of wintering birds. The drop-off in numbers in late October was a direct result of the presence of hunters in the area at that time. By March 29, some individuals were apparently in full nuptial plumage and many were in heavy molt.

This species was abundant on both the mud flats and sandy areas. It was seen in small numbers on gravelly shores and at least once with Killdeer on cultivated fields.

Pluvialis dominica. Golden Plover. A single bird of this species was seen on several occasions from May 6 until May 9 when it was collected and deposited in the Museum of Vertebrate Zoology. The bird was a male in nearly complete breeding plumage and weighed 146 grams. In wing length it falls in the area of overlap between *P. d. dominica* and *P. d. fulva* as given by Conover (Auk, 62, 1945:568-574).

I am aware of only one other California record for this species during the spring migration. This was recorded by Mrs. Kelly (Gull, 20, 1938:23) who has kindly sent me her notes on this bird: it was first reported on Bay Farm Island on April 25, 1938, and also was seen by Mrs. Kelly, May 7 and 8. By the latter dates the bird was in nearly complete breeding plumage.

The similarity of the dates when the two plover were seen is of interest as is the fact that both birds were seen feeding on rocky and gravelly shores covered with green algae.

Charadrius hiaticula. Semipalmated Plover. Present continuously from July 16 to June 10. The principal fall flight occurred in late July and early August (53 birds on July 28, and 56 on August 12), and the principal spring migration on April 20 (237 birds), April 23 (178), and May 6 (62). The high for wintering birds was 66 on January 13.

The Semipalmated Plover is apparently becoming more common as a wintering bird in the San Francisco Bay region. The first wintering record for the area appears to be that of Mrs. Allen (Gull. 24, 1942:27-28), and Mrs. Kelly (Condor, 46, 1944:243-244) has recorded wintering birds of this species in Alameda.

This species occurs on both mud flats and sandy areas in the study area.

Charadrius alexandrinus. Snowy Plover. This species formerly was to be found regularly on the southwest side of the Island. In recent years much of the sandy area of this part of the Island has been covered by filling operations, and this sand-inhabiting species has become scarce there. I have only two records for the observation period: two birds reported by Mrs. Kelly on September 12, and a single bird by Cogswell near the pipe-line at the western end of the Island on January 24.

Charadrius vociferus. Killdeer. Present all year. Approximately ten pairs were found on the area during the nesting season. The 59 Killdeer present on November 20 indicated that, in fall and winter, the numbers of this species are augmented by non-resident individuals. Partly-grown young were observed on April 23 and June 26. Killdeer were found most commonly on cultivated fields, but they also visited mud flats and sandy and gravelly areas.

Numenius phaeopus. Hudsonian Curlew. Present in small numbers throughout most of the study period. First seen July 1; last seen May 31. The 33 birds seen on August 4 and the 50 on August 16 were the only indications of migratory movements. Up to eight curlew were present through the fall, winter, and spring months. These curlew were found on mud flats and sandy and gravelly areas.

Numenius americanus. Long-billed Curlew. Rare. Seen on seven occasions between August 12 and September 15, with a maximum of two birds on the latter day. Single individuals were found on November 11 and January 13.

Limosa fedoa. Marbled Godwit. Common to abundant from early September to May. Some non-breeding birds remained through the summer. In 1948, this group numbered between two and three hundred, but fewer godwits were present through the summer of 1949. The principal fall flight

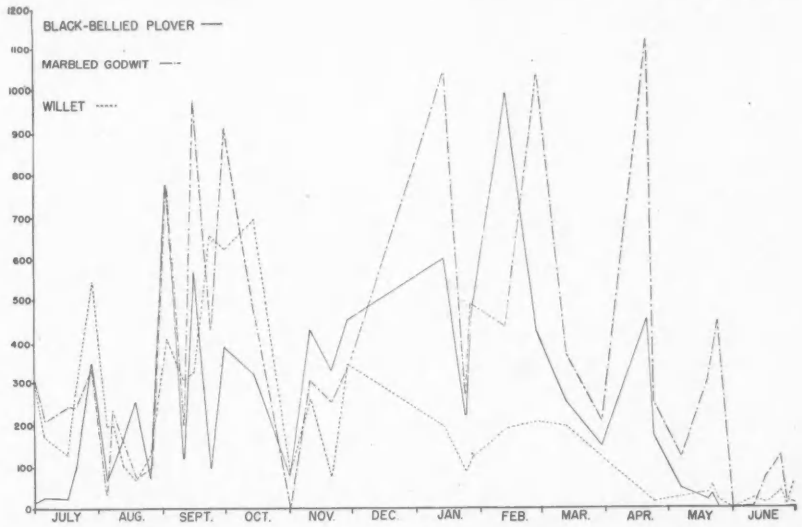

Fig. 3. Seasonal fluctuations in the abundance of the Black-bellied Plover, Marbled Godwit, and Willet on Bay Farm Island, July 1, 1948, to June 30, 1949.

occurred in September and the principal spring flight in April (see fig. 3). This species was most abundant on mud flats but also fed on sandy areas.

Totanus melanoleucus. Greater Yellow-legs. Present from July 1 to May 14, but never very numerous. The maximum number seen was 28 on September 2, and the greatest number in spring, 4 on May 14. The Greater Yellow-legs showed a decided preference for ponds, but was also found on sandy areas and occasionally on the mud flats.

Actitis macularia. Spotted Sandpiper. Rare, although according to Mrs. Kelly, at least one is reported in the area almost every year. One seen May 6 by S. T. Bailey was the only record for the period of this study.

Catoptrophorus semipalmatus. Willet. The status of the Willet was puzzling (see fig. 3). The species reached a peak in numbers of between six and seven hundred birds in late September and early October. The wintering population was lower, from 100 to 350 birds, until March; after this month the species became scarce. Willets were commonest on the mud flats, but also occurred on sandy and gravelly areas.

Arenaria interpres. Ruddy Turnstone. A rare transient spring and fall. Observed five times between July 28 and August 16 (maximum, 2) and four times between April 23 and June 10 (maximum, 5). Ruddy Turnstones were found on the mud flats as well as with Black Turnstones on gravelly

areas. The much greater range of ecological tolerances of *interpres* may well be a key to its much wider geographic distribution and greater numbers throughout much of its range.

Arenaria melanocephala. Black Turnstone. This species was present from July 16 to April 23. A flock of nine wintered on the gravelly dike on the northwest side of the island. This represents the maximum number seen on one trip. Black Turnstones were nearly always to be found on the gravelly dike and seldom anywhere else except on the adjacent areas of irregularly caked mud uncovered by the tide. The latter had more the configuration of rocks than of mud flats and for this reason may have been attractive to the turnstones.

Limnodromus griseus. Short-billed Dowitcher. Abundant transient, less common in winter (see fig. 4). The fall flight was protracted, lasting from early July until mid-November. A winter low

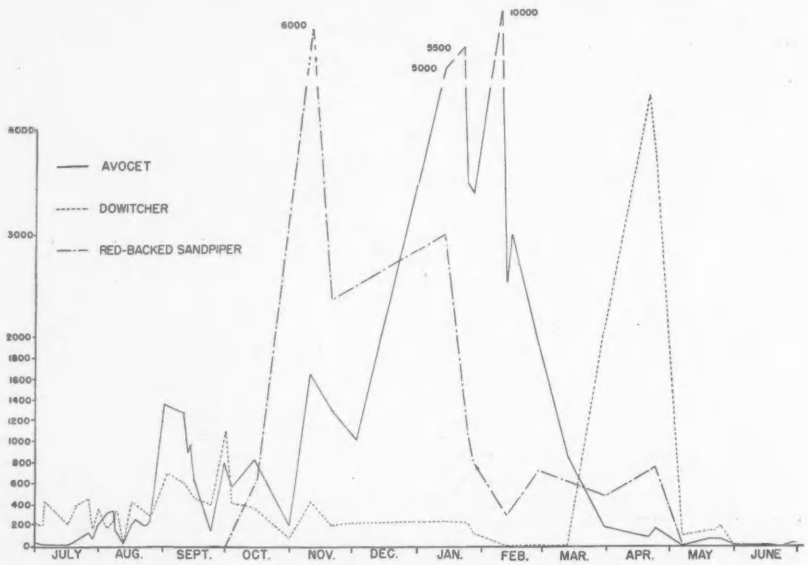

Fig. 4. Seasonal fluctuations in the abundance of the Avocet, Short-billed Dowitcher, and Red-backed Sandpiper on Bay Farm Island, July 1, 1948, to June 30, 1949.

occurred from mid-February to mid-March. The spring flight was very large, reaching a peak of approximately 4300 birds on April 23. A few non-breeding dowitchers were present through the month of June. No Long-billed Dowitchers (*L. scolopaceus*) were identified, although some may have been present. On May 19, F. A. Pitelka accompanied the writer on a census and identified all the dowitchers seen closely enough as *L. griseus*. A dowitcher, found dead on April 23 and preserved as a skin in the Museum of Vertebrate Zoology, is also *L. griseus*.

The Short-billed Dowitcher shows a definite preference for mud flats during the feeding periods. The majority was found feeding in the shallow water and following the retreating water-line during ebb tide.

Capella gallinago. Wilson Snipe. An uncommon winter visitor to the salicornia beds and vegetable gardens. Found on six occasions from October 31 to February 26 with a maximum of six individuals on the latter date.

Calidris canutus. Knot. An uncommon transient. One fall record, a single bird on August 18; more numerous in spring, six records from April 3 to May 21 with 78 birds on April 23 and 75 on May 5.

The Knot's partiality to sandy areas accounted for its scarcity on Bay Farm Island. The feeding mannerisms of the Knot were found to be useful in distinguishing this species from the Short-billed Dowitcher. On May 6, while a group of Knots was feeding in company with some Dowitchers, it was noted that the Dowitchers fed by repeatedly plunging the bill deep into the sand, the head moving vertically an inch or two with each thrust, whereas the Knots put only the tip of the bill into the sand, the head moving rapidly up and down through a distance of one-half to one-fourth of an inch.

Crocethia alba. Sanderling. Uncommon in winter and spring; more numerous in fall migration. Extreme dates for fall flight, August 4 and September 30, with a maximum of 205 on September 15. One winter record, two birds on January 24. Seen three times between March 29 and May 6 with a maximum of 8 on April 23.

Like the Knot and the Snowy Plover, the Sanderling's scarcity on Bay Farm Island was due to its preference for sandy beaches. That preference was reflected in the fact that it occurred almost exclusively on sandy areas there.

Ereunetes mauri. Western Sandpiper. The most abundant species of shorebird on Bay Farm Island (see fig. 2). The southward flight was protracted, lasting from early July until late November; the wintering population reached a minimum of 2300 on February 12; and the spring peak of approximately 26,500 birds was reached on April 23. The figures for this species undoubtedly include some Least Sandpipers, but the latter seldom occurred in large numbers. Western Sandpipers fed over both sandy and muddy areas.

Erolia minutilla. Least Sandpiper. The figures for the Least Sandpiper are the least satisfactory of those for any species, due to the impossibility of distinguishing this species at a distance from the more numerous Western Sandpiper. Least Sandpipers were observed from July 5 until April 23; and although probably overlooked after the latter date, they were certainly not numerous. This species was common from August 12 until January 13 with a peak of approximately 1700 birds on September 30. No large spring flight was observed.

When present, Least Sandpipers were usually found on gravelly areas covered with green algae. They also occurred commonly on the upper parts of the mud flats. The absence on Bay Farm Island of an especially favored habitat of this species (marshy areas with low grass) may account for the irregularity of the numbers of the Least Sandpiper there.

Erolia alpina. Red-backed Sandpiper. An abundant winter resident. Seen from September 23 to May 6; large numbers present from October 14 to April 23. A maximum of nearly 6000 was present on November 10. No spring peak was noted (see fig. 4). Red-backed Sandpipers were most numerous on the mud flats, most often feeding in the water near its edge, and, with the dowitchers, forming a line just beyond the water's edge.

Recurvirostra americana. Avocet. Only in recent years has the Avocet become common at Bay Farm Island. It was present through the whole period of this study, but common only during the fall and winter (see fig. 4). A maximum of approximately ten thousand was reached on February 9. Avocets fed almost exclusively in the water over the mud flats and in the pond (J).

Phalaropus fulicarius. Red Phalarope. This species appeared in late May and was found on five days between May 17 and 24, with a maximum of 20 on May 19. Red Phalaropes were of irregular occurrence on the Island and were usually found with the more numerous Northern Phalaropes. Both species were found on the ponds, the water over the mud flats, and occasionally foraged on the mud flats proper.

Lobipes lobatus. Northern Phalarope. Found regularly but in small numbers during the spring and fall migrations. Seen on 18 days between August 3 and September 23, with a maximum of 63 on August 25, and on six trips between April 23 and May 24, with a maximum of 144 on May 17. During the spring flight, individuals of both species of phalarope were found in full nuptial plumage, in winter plumage, and in various intermediate stages.

University of Michigan Museum of Zoology, Ann Arbor, Michigan, January 27, 1951.

PRIOR DESCRIPTION OF TWO MEXICAN BIRDS BY ANDREW JACKSON GRAYSON

By LOIS CHAMBERS TAYLOR

On January 30, 1871, George N. Lawrence read a paper before the Lyceum of Natural History of New York describing several new species of birds (Ann. Lyc. Nat. Hist. New York, vol. X, nos. 1-3, 1-21, issued in February, 1871). Lawrence introduced these descriptions as follows:

"Some of the birds described in this paper were obtained by the late Col. A. J. Grayson, of Mazatlan, most of them on the Island of Socorro, off the Pacific coast of Mexico. Col. Grayson's collection, with others made in Northwestern Mexico, were kindly placed in my hands by Prof. Henry, of the Smithsonian Institution, for examination, with a view to furnishing a catalogue of them, in which the notes of Col. Grayson are to be incorporated. As some time will elapse before this can be prepared and published, I have thought best, preliminary to its appearance, to describe the new species.

"Several of the species have MS. names given them by Prof. Baird, which in all such cases have been retained." The paper referred to by Lawrence appeared later in the same year (Proc. Bost. Soc. Nat. Hist., vol. XIV, 1870–71:261-302, June 7, 1871).

Among the birds described in this paper, two concern us here, the Socorro Wren, *Troglodytes insularis* "Baird MS." Lawrence and the Socorro Towhee, *Pipilo carmani* Lawrence. In both cases, the type specimens indicated by Lawrence were collected by Andrew Jackson Grayson.

We may assume that both Baird and Lawrence were unaware that Grayson had described these two birds three years previously in a flourishing San Francisco paper known as "The California Farmer and Journal of Useful Sciences." This weekly had a wide circulation and published many popular articles on scientific subjects as well as some of a more serious nature.

Among the "Farmer" contributors in natural history were Dr. J. G. Cooper, Dr. C. F. Winslow, F. Gruber, and Alexander S. Taylor: But in ornithological bibliographies checked, no mention of the "California Farmer" has been found.

One might wonder why Grayson failed to inform Baird that he had described these species. And why had not Baird or Lawrence become aware of the publication in the "California Farmer"? The oversight is probably to be explained by the difficulties of correspondence and transportation between the Pacific and Atlantic coasts in the 'sixties. It is apparent from the Grayson papers deposited in the Bancroft Library of the University of California that many letters written by Grayson or Baird to the other never reached their destinations. Possibly Grayson did not realize fully that his published descriptions in the "California Farmer" would or could stand as original descriptions which, because they appeared first, would nullify the work of his eastern collaborators. Grayson died a short time later, in August of 1869. It is probable that Grayson's descriptions were overlooked heretofore because many files of early California journals were destroyed in the San Francisco fire of 1906, making them unavailable except in certain historical archives. Nevertheless, Grayson must have been somewhat aware of the significance of this publication, as indicated by a letter in the papers of Colonel James Lloyd LaFayette Warren (Bancroft Library). In this letter to Warren, who was editor of the California Farmer, Grayson wrote as follows on October 5, 1867:

"If you have no objections, I propose making the 'Farmer' a mechanism in which to make known the new discoveries I have made in Ornithology. This is customary in all Scientific Journals, although to the general reader of Newspapers these articles doubt-

less are very dry—particularly the technical description, which is, however, the most important to the ornithologist, and particularly to me, as it gives preeminence, as the first to describe a new species.

"Enclosed you will find a MS of one, which if it suits, will be followed by others, mostly from Socorro and the Tres Marias Islands and new facts of others upon the mainland."

Fig. 1. Left, *Pipilo socorroensis* Grayson. Right, *Thryomanes sissonii* (Grayson). Photographs of original paintings by A. J. Grayson made in 1867.

The manuscript was doubtless that describing the Socorro Towhee, for some weeks later the following article appeared in the "California Farmer and Journal of Useful Sciences" (vol. 28, no. 16:127, October 24, 1867):

New Discoveries in Ornithology

(By Col. A. J. Grayson, of Mazatlan)

We are very much gratified to say to our readers, and especially to all who are interested in the Science of Ornithology, that the "California Farmer" has been selected by this very distinguished artist in the science as a medium of making known all discoveries he has made and shall make, and which he is desirous of communicating to the world abroad.

We lay before our readers the first number of the series, which will be regularly furnished, and which will be gladly hailed by the scientific world.

[New Series—No. 1]

Socorro Tawhee [*sic*] Finch, or, The Water Finder. *Pipilo Socorroensis*. (G) Nov. sp.

I was not a little surprised on finding in this remote and isolated locality a bird so nearly allied to and so closely resembling in its general appearance a common species found in the Atlantic Southern U. S. (*P. Erythrophthalmus*), . . .

The three Pipilos that closely resemble each other described in Baird's "North American Birds," P. Oregonus, P. Arcticus, P. Megalonyx, are all Western species; but they are all larger than the present bird, which I am sure is a new variety hitherto unknown, or described. I have given it the provincial name of the Island upon which it is found, meaning in the Spanish language, Succor, and which is the most appropriate name that could be given to it, from the fact that this bird led to the discovery of the only water found upon the Island, . . . thus preserving the lives of the whole party.

It is strange that this should be the only representative of the extensive family Fringillidae found upon the Island, where this species appears to be the most abundant of the feathered inhabitants of this locality. Like its congeners, it is modest in its attire and its habits; generally confining itself to

the low bushes, or on the ground, where it seems to be constantly engaged in scratching up the dry leaves and grass with its stout claws in search of insects or small seed upon which it subsists. They also feed upon the numerous land crabs, or the remnants of those left by the yellow crowned night heron, or red tailed hawk . . . They are remarkably tame; numbers of them came around our camp, picking up the crumbs of bread and even bits of fish . . . Its song is rather feeble, but resembling the other members of this genus.

From appearance, the breeding season was near at hand, (this about the middle of May) although I found no new nests, but several of last year's nests. These old nests were composed of leaves and coarse grass, round and compact in form, and lined with a softer material.

A fact may be related here in regard to the breeding season of all land birds of these latitudes. It does not commence with many species till about the setting in of the rainy season, which is the latter part of June, and I believe this to be the case with all the birds of Socorro Island.

Specific Characters

Form robust, bill strong conical, commissure and culmen gently curved, angulated at base, the cutting edges convex. Nostrils basal. Feet and claws very stout, nails compressed, moderately curved and very long, that of the hind toes as long or longer than its digits, and with the toe nearly as long as the tarsus. The middle toe with nail a little longer than the tarsus. Wings short, rounded and concave, 4th and 5th primary quills longest. Tail moderate length, and rounded.

Adult male. Bill Black. Iris reddish hazel, feet brown, nails brown. Head, neck, and upper parts of breast all around black with a brownish tinge, terminating on the breast in irregular spots of white and black, extending from which is a broad streak of dirty white as far as the ventral region. Sides and under tail coverts chestnut red, the latter rather paler. The entire upper parts except head and neck, including the tail, is of a dark brown, with a tinge of alivaceous [*sic*] more conspicuous upon the outer webs of the quills and tail feathers. Upon the back or interscapular region there are a few rather obscure dark streaks of brown. The inner webs of the two lateral tail feathers tipped with white for about a terminal 3rd of an inch on the outer feather, and still less on the next. The greater and lesser wing coverts distinctly tipped with white on the outer edges. The outer webs of the scapular and two inner secondaries slightly marginated with dingy white.

Female and younger birds similar, but the colors are of a paler hue.

Total length, 6 in. . . .

Remarks

This bird differs from the other species of this genus which have been described by its smaller size. It seems to approach near to P. Megalonyx (Baird) which is found in Southern California, but of smaller size, and a considerable difference in the markings of the plumage. It is closely allied, but decidedly a new species. Specimens . . . sent to Prof. Baird, of the Smithsonian Institute.

It is thus clear that *Pipilo carmani* Lawrence 1871 is a synonym of *Pipilo socorroensis* Grayson 1867. Since Lawrence in his description of *Pipilo carmani* had named as types two specimens collected by Grayson it seems suitable to make the first of these, number 50843 U. S. Nat. Mus., the type of *Pipilo socorroensis* Grayson.

A manuscript invoice in Colonel Grayson's handwriting states that he sent to the Smithsonian Institution July 20, 1867, five specimens of the Socorro Towhee and five of the Socorro Wren. Among those sent to the Smithsonian were the individuals indicated as the models for his paintings. Grayson's field catalogue shows that he collected a total of 12 specimens of the Socorro Towhee and 12 of the Socorro Wren. A clue as to the disposition of the remaining skins may be found in a letter written to Colonel Grayson by Spencer Fullerton Baird on July 19, 1868, from which I quote the following:

"I was very sorry to learn that you had been obliged to sacrifice your collection and hope that you had sent specimens of all the species previously to us. Were there any Tres Marias and Socorro species among them? Let me know particularly if this was the case. Also who the parties were that bought them, and to whom they were to be sent in England. I have not yet been able to finish up the paper on the Island birds, and fear lest Sclater or Salvin may get hold of the species and describe them before I do."

Grayson's description of the Socorro Wren appeared on January 9, 1868 (The California Farmer and Journal of Useful Sciences, vol. 29, no. 1:7). From it, the following is quoted:

Exploring Expedition to Socorro Island from Mazatlan, Mexico.
By A. J. Grayson, of Mazatlan.

Thryothorus sissonii. Socorro Wren. (New sp.) . . .
Number Two . . .

This diminuitive species is very abundant, and well distributed over the island. As other members of this family, its attire is modest and unpretending, but its song may be heard throughout the day, either among the trees, or brushy-covered rocks, that crop out everywhere. . . . . I never tired watching them climbing about over old logs, or the trunks of standing trees, creeper like, and often turning up the leaves on the ground at our feet, in search of food. . . . .

They had not yet, during my stay, fully commenced nesting. I however found a nest without eggs, in a knot-hole of a decayed tree, which sufficiently proved to me, that they rear their young in such situations, or in the cavities of rocks, and not in the branches of trees or bushes, as one species does on the main shore. (*Thryophilus* Sinaloa.) Baird . . .

As a compliment to my esteemed friend, the U. S. Consul at Mazatlan, and for his generous disposition and good will in aiding me in various ways, not only in the expedition to the Island of Socorro, but his appreciated friendship in the cause of which I am daily at work, I have as a poor recompense dedicated this species to his name.

Specimens of this, as well as all the land birds of the Island, have been sent by me to the Smithsonian Institute, where they will remain in the National Museum for Identification.

Specific Characters:

Form small, Bill compressed, rather lengthened, longer than the head, culmen and commissure gently curved throughout, no perceptible notch at tip. Nostrils in the lower edge of anterior extremity of the nasal groove, narrow, elongated, overhung by a stiff, scaly like roof of the membrane of the upper part of nasal groove.

Wings short and rounded, fifth and sixth quill longest; the first very small or spurious. Tarsus long—longer than the middle toe. Anterior scutellae distinct. Lateral toes equal. Hind toe long, and rather stout. Tail moderate length; slightly rounded.

Iris dark brown. Bill dark brown above, paler below—under mandible pale yellowish flesh color. Feet brown. Entire upper parts of plumage ashy brown. Wings distinctly barred with black on the outer webs. Tail broadly barred with black. Sides of head pale rufous, with spots of brown—dirty white streak above and behind the eye, as far as nape. Entire under parts dirty white, or pale ochoreous; flanks and sides darker. Under tail coverts barred with dusky transverse bands. Concealed spots of white on the ends of the rump feathers.

Total length, 5 inches. Wing, 1.80; Tail, 1.75; Tarsus, 0.75; Bill, 0.60; Gape line, 0.78.

Hab. Socorro, one of the group of Islands known as the Revillagigedo Isles, off the coast of Mexico, in the Pacific Ocean.

Troglodytes insularis Lawrence 1871 is thus a synonym of *Thryothorus sissonii* Grayson 1868. This wren is a geographical representative of the continental Bewick Wren, *Thryomanes bewickii* (Hellmayr, Cat. Birds Amer., part 7, 1934:215), and its name therefore stands as *Thryomanes sissonii* (Grayson). As Lawrence also designated Grayson's specimen as the type of *Troglodytes insularis*, it seems quite in order to make this specimen, number 50810, U. S. Nat. Mus., the type for *Thryomanes sissonii* (Grayson).

Grayson made paintings of both the Socorro Towhee and the Socorro Wren which are here reproduced for the first time (fig. 1). These paintings as well as the documents and other materials used in this report were made available through the courtesy of Dr. George P. Hammond, Director, and the staff of the Bancroft Library, University of California, Berkeley, California.

Museum of Vertebrate Zoology, University of California, Berkeley, California, November 15, 1950.

BREEDING SEASONS OF HUMMINGBIRDS NEAR SANTA BARBARA, CALIFORNIA

By FRANK A. PITELKA

Western species of hummingbirds which overlap in their breeding distribution are more or less segregated into different habitats (Grinnell and Miller, Pacific Coast Avifauna No. 27, 1944:216-255), but they resemble each other in basic traits of behavior, particularly in mode of feeding and in territorial relations (Pitelka, Condor, 44, 1942: 194-201) to the extent that some overlap in habitat distribution occurs. In the Berkeley Hills, on the east side of San Francisco Bay, a significant amount of interspecific strife affects population densities of the two breeding species, the Anna (*Calypte anna*) and Allen (*Selasphorus sasin*) hummingbirds (Pitelka, Ecol., 32, 1951: in press). An equally interesting situation, yet to be examined in detail, exists in the vicinity of Santa Barbara, California, where four species of hummingbirds breed. These are the Anna, Allen, Black-chinned (*Archilochus alexandri*), and Costa (*Calypte costae*). Data on breeding seasons in these species near Santa Barbara are presented here together with a brief, exploratory discussion of ecological overlap between them.

A total of 331 dates are available for nests under construction and eggs in nests. Each date represents a separate nesting. The seasonal distribution of the records for each of the four species is shown in figure 1. Most of the records were obtained from the files of the Santa Barbara Museum of Natural History where the oological collection of W. Leon Dawson is located. For the privilege of examining those files and using the data, I am indebted to Egmont Z. Rett. Additional data for Santa Barbara and Ventura counties were provided by Sidney B. Peyton and Lawrence C. Stevens from their oological collections and by Arthur E. Hutchinson from his field records. I acknowledge their generous cooperation. A few records were obtained from the egg collection of the California Academy of Sciences through the courtesy of R. T. Orr and M. L. Perry and from reports published in the Condor and the Oologist.

From the data in figure 1, the following points can be made: The permanently resident Anna Hummingbird has the longest breeding period, from late December to mid-June, and two broods (occasionally three?) are raised per season. Near Santa Barbara, this species begins to breed a full month to six weeks ahead of the Allen Hummingbird, and this difference also occurs between the same two species in the San Francisco Bay region (Pitelka, *op. cit.*). That nesting in the Anna Hummingbird may be well underway by the time Allen nesting begins is indicated in figure 1 not only by the records from the Santa Barbara area but also by 51 records from Santa Monica, Los Angeles County, for the years 1901 and 1902 (Chambers, Condor, 5, 1903:133). The distribution of dates for *anna* in figure 1 of course should not be taken to indicate relative amount of nesting activity in different parts of the breeding season; it probably indicates only that nests of *anna* are usually sought most frequently and found most easily in the first third of the season when *sasin* is only starting to nest and when the other two species have not yet appeared.

In the Anna Hummingbird, nest-building has been recorded as early as December 11 (1941), at Altadena, Los Angeles County (W. I. Allen, Condor, 44, 1942:129). An even earlier record, reported by Bowles (Condor, 12, 1910:125-127) and based on an observation of a female supposedly feeding a fledgling on January 3, seems doubtful because of the inadequacy of his evidence and the circumstantial nature of it.

The species other than *anna* are all summer residents. As is shown in figure 1, in the Allen Hummingbird two broods are usually raised. In the Black-chin and Costa, prob-

ably only one brood is raised per season. The Allen begins to nest in early February, the other two do not do so until mid- or late April. In the late nesting species, nests with eggs may be found in late June and even early July, whereas in the other two species, nests with eggs are generally not found after mid-June. Thus, real differences occur among the four species in length and timing of breeding periods. Taking the nestling period into account, overlap in nesting periods occurs from mid-April through June.

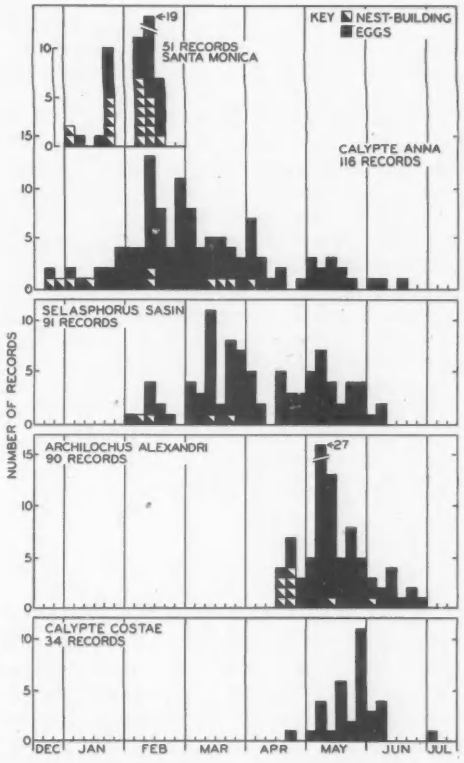

Fig. 1. Breeding seasons of four species of hummingbirds near Santa Barbara, California, showing frequency distribution of nesting dates in five-day intervals.

In the Santa Barbara area, three of these species (*anna, sasin,* and *alexandri*) overlap in habitat distribution of nesting females. Competition for space or food or both may thus be expected to occur. For their bearing upon these matters, the differences in breeding periods must be examined in the light of other pertinent information. Such differences can relieve or intensify competition. Some information on this situation is provided by data accumulated by Mr. and Mrs. Arthur E. Hutchinson of Santa Barbara and generously given to me for study.

The fact that the Anna, Allen and Black-chinned hummingbirds overlap locally in breeding distribution is shown by results of breeding-bird censuses published by the Hutchinsons (Audubon Mag., supplements, 1944-1947). They studied a 17-acre stand of mature live oaks (*Quercus agrifolia*) traversed by a canyon creek along which three species of deciduous, riparian trees (*Platanus, Populus,* and *Salix*) were more or less mixed with the oaks. The hummingbird nests recorded in four successive years are as follows:

	Anna	Allen	Black-chin
1944	10	7	9
1945	10	4	5
1946	10	10	21
1947	1	7	5
	31	28	40

These results indicate that within a general habitat type such as oak woods along a canyon stream, the three species may breed in fair numbers. This applies specifically to the females and their nesting activity, since the males do not participate in nesting and usually maintain territories in different habitats (Grinnell and Miller, *op. cit.*).

Those nests on which Mr. Hutchinson had adequate information have been tabulated according to site, distance from ground, and distance to nearest active nest of another hummingbird. With respect to site, the following results were obtained.

	Anna	Allen	Black-chin
Live-oak	29 nests	21 nests	26 nests
Sycamore	1	2	11
Poplar			1
Vine		2	1
Fern		1	
	30	26	39

With respect to height from ground, nests were classified into frequency classes of five-foot intervals. Twenty-seven nests of *anna* ranged from 5 to 30 feet; the modal class was 11-15, with 12 nests. Twenty-two nests of *sasin* ranged from 2 to 25 feet; two equal modal classes, 6-10 and 11-15, included 12 nests. Thirty-seven nests of *alexandri* ranged from 3 to 30 feet; the modal class was 6-10, with 16 nests. These figures must be regarded as merely approximate, as in the original census work, full details were not recorded concerning nest location. Nevertheless, we have a fair sampling of nests from a 17-acre area, and the data suggest a significant amount of overlap in both heights at which nests are usually placed and sites usually used. Thus, either this description of the nest sites is too gross to pin down important ecological differences, or some interspecific adjustments in the numbers and local distribution of nesting hummingbirds occur, or both.

The data on distances between active nests disclose additional interesting points. In the following tabulation, numbers of neighboring nests are given together with extremes of distances in yards between them.

	Anna		Allen		Black-chin	
Anna	20 nests	(20–50)	4 nests	(15–25)	3 nests	(20–25)
Allen	6	(18–40)	10	(28–50)	8	(18–40)
Black-chin	3	(20–42)	4	(18–37)	23	(15–75)

In the Anna Hummingbird, for example, among 29 nests, the nearest neighbor with an active nest was another Anna Hummingbird in 20 instances, an Allen in 6 instances, and a Black-chin in 3 instances. The results suggest that in a given species the nearest neighbors will more likely be the same species than either of the other two species. This at once suggests that some segregational factors are operating in addition to the partial separation resulting from seasonal differences in nesting. About this and other aspects of hummingbird distribution near Santa Barbara, we should like to know more. It is up to some interested observer to capitalize on the excellent opportunity which this general problem affords.

There is some question concerning identification of nests of the Costa Hummingbird in the Santa Barbara area. The Costa Hummingbird is a species characteristic of deserts and dry, broken chaparral; it is not to be expected in woodland and riparian habitats where, near Santa Barbara, the Anna, Allen, and Black-chinned hummingbirds occur. Yet Dawson (Birds of California, 2, 1924:951), referring to that area, states that "the Costa Hummers join their fellows of three other species in seeking sites close to running water." He speaks of nests in "oaks, alders, sycamores, or bays, and sometimes within two feet of the water." This occurrence is to be doubted on ecological grounds. Females of the Costa and Black-chinned hummingbirds are exceedingly difficult to distinguish in the field, and as Dawson believed that dependable species distinctions could be made on the basis of nest structure, he probably misidentified nests if they deviated from the nest structure he regarded as typical of the species. Variation in nest structure within a species may of course be such as to invalidate the diagnostic value of nest ornamentation thought to be characteristic. If Dawson's identification of females of the Costa Hummingbirds nesting in the situations mentioned above is correct, this must be proven with collected breeding specimens. Referring again to figure 1 and the 34 nestings of the Costa Hummingbird graphed there, only seven of them are from Dawson's records; and although a few of Dawson's records may be based on misidentifications, the distribution of records shown there is probably an adequate approximation of the nesting season of that species near Santa Barbara.

Museum of Vertebrate Zoology, Berkeley, California, December 28, 1950.

FROM FIELD AND STUDY

Nesting Density of Virginia and Sora Rails in Michigan.—During the summer of 1950 I made observations on a breeding population of Virginia Rails (*Rallus limicola*) and Sora Rails (*Porzana carolina*) in a roughly oblong half-acre of marsh lying along the north edge of a fifteen-acre wooded swamp near Dixboro, Washtenaw County, Michigan. Throughout this particular marsh the water was about a foot deep (shallower along the north edge), the growth of cattail (*Typha latifolia*) and coarse sedge (*Carex* sp.) was fairly uniform, and there was a scattering of low buttonbushes (*Cephalanthus occidentale*). The marsh was more or less surrounded by higher vegetation—a dense fringe of shrubbery just to the north, and tall buttonbushes and willow trees (*Salix* sp.) in other directions.

I found five Virginia and four Sora nests in an area slightly less than half an acre in extent. So far as I could see, the two species chose exactly the same sort of nest site. Some nests were in small, more or less isolated clumps of sedge, others in larger, less definite mixed clumps of sedge and cattail. All the nests were a very short distance (2 to 5 inches) above water level.

The maximum distance between any two of the nine nests was 267 (measured) feet; the shortest distance between a Virgina and Sora nest, 14 feet, 2 inches; between two Virginia nests, 33 feet; between two Sora nests, 80 feet, 7 inches. The shortest distance between a nest (Virginia) and dry ground was 22 feet; the greatest distance (Sora), 102 feet. All nine nests were active simultaneously and at least eight of them were successful.

The earliest date on which I found a Sora nest was May 12; on that date I found two nests, one with 2, the other with 4 eggs. The earliest date on which I found a Virginia nest was May 16; on that date I found two nests, one with 3, the other with 7 eggs. Virginia eggs began hatching June 4, seven days later than in either 1948 or 1949, when nests were more widely distributed. Sora eggs began hatching June 2, ten days later than in 1948 (no Sora nests were found in the study area in 1949). Growth of vegetation was retarded by low temperatures in the spring of 1950 and the rails did not nest in certain adjacent areas they had occupied the two previous years. The existence of suitable cover within the circumscribed area, and the absense of it elsewhere in early May may therefore have been largely responsible for this concentration of nests there.—ANDREW J. BERGER, *Department of Anatomy, University of Michigan Medical School, Ann Arbor, Michigan, February 15, 1951.*

The Lucifer Hummingbird in the United States.—The Lucifer Hummingbird (*Calothorax lucifer*) was first recorded for the United States in the "American Sportsman" (1875, 5:328). Henshaw (Rept. Sec. War, 2(2), 1875:1070, 1082) listed a single individual (U. S. Nat. Mus. no. 72535) from near Camp Bowie, Arizona. on August 8, 1874. The female specimen in question was at that time reported as another species (*Doricha enicura*) but, when examined again by Lawrence, was correctly determined as *Calothorax lucifer* (Bull. Nutt. Ornith. Club, 2, 1877:108-109). Ridgway, in a monograph on "The Hummingbirds" (Ann. Rept. U. S. Nat. Mus., 1890 (1891):359-362), gave a detailed account of the Lucifer Hummingbird and referred particularly to the Camp Bowie specimen. In addition, he figured a female in plate 42 (opposite page 360), the caption of which stated "Female. (Cat. No. 115294, U. S. N. M. Arizona. Collected by O. T. Baron.)" The latter specimen could not be found in the National Museum collection, but reference to the Museum catalogue indicated that it was entered in the records on January 29, 1889, and that it was purchased for $2.50. In a letter dated November 11, 1888, to Robert Ridgway, Baron apparently made reference to this bird by stating "The ♀ H. bird I shot in Arizona I shall send to you as soon as I get to S.[an] F.[rancisco) etc."

Oberholser (Auk, 19, 1902:300) was the first to list the species for Texas when he stated: "Taken in the Chisos Mountains." His statement was based on an immature male (U. S. Nat. Mus. no. 168401) which he secured in Pine Canyon at 6000 feet on June 6, 1901, and on a male and female collected by L. A. Fuertes at the same place on June 7, 1901. (The Fuertes specimens were recorded previously as May 7, 1901.) Mrs. Florence Merriam Bailey (Handbook of Birds of the Western United States, 1902:243) stated: "In the Chisos Mountains in western Texas, Mr. Bailey found the Lucifer hummer with several other species common [?] in June [1901] about the big agaves, which were then in full flower." Ridgway (U. S. Nat. Mus. Bull. 50, pt. 5, 1911:653) stated, "Chisos Mountains, breeding," and the A. O. U. Check-list (1931:179) listed the Chisos Mountains in the range of the species. Since

Vernon Bailey, Harry C. Oberholser, and Louis Agassiz Fuertes comprised the field party of 1901 under the auspices of the United States Bureau of Biological Survey (now Fish and Wildlife Service), all of the foregoing references for Texas were based on their investigations.

In addition to the two specimens which Fuertes obtained in 1901, Van Tyne and Sutton (Univ. Mich. Mus. Zool., Misc. Pubs., 1937, No. 37:43) recorded two more from the Chisos Mountains: male, Juniper Canyon, 5500 feet, May 17, 1933, John B. Semple; and male, banks of Rio Grande, 3 miles west of Boquillas, May 17, 1935, by George M. Sutton.

The latest record of the species for the United States is an immature male (U. S. Nat. Mus. 417862) taken by Walter P. Taylor on June 27, 1944, at the Basin, Chisos Mountains, 5500 feet, in course of a biological investigation (in company with W. B. Davis and W. B. McDougall) of the Big Bend National Park. The hummer was feeding among the brilliant flowers of a tall agave (*Agave scabra*) apparently inserting its bill down into each bloom.

The Lucifer Hummer is one of the rare species within our borders, and of the eight specimens known from the United States, six have been secured in the Chisos Mountains. Although the two specimens by Semple and Sutton had the gonads "much enlarged," and although Ridgway listed the species as "breeding," no nest has yet been found in Texas or in any other area in the United States. Thus, it cannot be stated with certainty that the Lucifer Hummingbird breeds within our borders.—WALTER P. TAYLOR, *Oklahoma Cooperative Wildlife Research Unit, Stillwater, Oklahoma, and* ALLAN J. DUVALL, *Fish and Wildlife Service, Washington, D.C., February 20, 1951.*

A Summer Record of the Great Gray Owl in Oregon.—While driving north on the highway a few miles south of Chemult, Klamath County, Oregon, in bright sunlight in mid-morning of June 4, 1950, I had a very brief sight of a large owl perched on a limb about ten feet above the ground in a lodgepole pine tree. As we passed the bird, at a speed of about 45 miles per hour, I realized from its general shape that it did not appear to be a Horned Owl, the common large owl in this general region. On return to the place a few moments later, I found the bird perched on the same limb. The bird was collected and proved to be an adult female Great Gray Owl, *Strix nebulosa nebulosa*. Examination of the gonads showed no activity whatever. The bird was very fat and its stomach was empty at the time of collecting.

The only other summer record of this species for Oregon, of which I have knowledge, is an adult male skin in my collection, taken in the yellow pine forest near Hardman, Morrow County, Oregon, on August 14, 1932 (Gabrielson and Jewett, Birds of Oregon, 1940:349).—STANLEY G. JEWETT, *Portland, Oregon, January 8, 1951.*

A Quail from the Oligocene of Colorado.—The most ancient record of any American quail (subfamily Odontophorinae) heretofore reported is of *Miortyx teres* Miller, from the Lower Miocene (Flint Hill local fauna, late Arikareean) of South Dakota (A. H. Miller, Univ. Calif. Publ. Geol. Sci., 27, 1944:93-95). In addition to this fossil genus, two extinct species of quail belonging to surviving genera have been described by Wetmore: *Cyrtonyx cooki,* from the Upper Miocene ("upper Sheep Creek beds") of Nebraska (Condor, 36, 1934:30), and *Colinus hibbardi,* from the Upper Pliocene (Rexford formation, Blancan age) of Kansas (Univ. Kansas Sci. Bull., 30, pt. 1, 1944:96-98). The several Recent species of quail recorded from the Pleistocene complete the known fossil history of the Odontophorinae.

It is a matter of interest in regard to the antiquity of the Odontophorinae, therefore, to report here the remains of a quail from the Middle Oligocene of northeastern Colorado. The specimen, Univ. Kansas Mus. Nat. Hist. no. 9393, consisting of the distal end of a left tarsometatarsus, was obtained in the summer of 1948 by Edwin C. Galbreath, of the University of Kansas Museum of Natural History. The geological age and locality of the specimen are as follows: silts of Orellan age in the Cedar Creek facies of the White River formation, SW. ¼ sec. 12, T. 11 N., R. 54 W., Logan County, Colorado.

The tarsal fragment represented by the fossil is well preserved, with the shaft broken approximately 2.5 mm. proximal to the distal foramen. The middle trochlea is intact and little worn. The inner trochlea is missing, as is most of the lateral flange of the outer trochlea. The fragment is 8.1 mm. long. It is creamy-white in color and is heavily mineralized.

Study of this bone has made it necessary for me to examine modern skeletons of *Cyrtonyx,*

Oreortyx, Callipepla, Lophortyx, and *Colinus,* as well as four comparable elements of the extinct *Colinus hibbardi Cyrtonyx* has a proportionately much stockier shaft in relation to the trochleae than has the fossil. In *Callipepla* and *Oreortyx,* the small foramen leading distad from the antero-distal margin of the distal foramen has a different appearance than in *Lophortyx, Colinus,* and the fossil. In *Callipepla* and *Oreortyx,* the small foramen does not appear to open directly into the distal foramen, as in the other quail named, but opens on a small lip or shelf which separates the two foramina. I have encountered great difficulty in finding definitive characters to separate the distal portion of the tarsometarsus of *Lophortyx* from that of *Colinus.* In discussing *Colinus hibbardi* (cited above), Wetmore says (p. 97) "*Lophortyx* differs [from *Colinus*] in the more angular development of the posterior side of the middle trochlea." This seems to me to be only an average difference, being quite unreliable in the identification of a majority of individual bones.

Confronted, therefore, with my own inability to separate *Lophortyx* from *Colinus* on the basis of the tarsometarsus, I have been unsuccessful in allocating the fossil to either genus, or in finding definitive characters by which a new genus might be named. Upon direct comparison, the fossil appears to be smaller than the comparable elements of *Colinus* (*virginianus*) and *Lophortyx* (*gambelii* and *californica*) and to have the distal foramen somewhat farther from the external intertrochlear notch. However, eight measurements taken of the fossil and of a series of modern *Colinus* and *Lophortyx* show that although the fossil is definitely smaller in all dimensions than the averages of the modern specimens, in each measurement some overlap occurs. The width of the intact middle trochlea of the fossil is 2.2 mm.; the depth 2.9 mm. The breadth of the shaft of the fossil at the proximal end of the distal foramen is 4.2 mm.

If the Oligocene quail here discussed were represented by more diagnostic skeletal elements than the tarsometarsus, it would doubtless prove to be a new species, and perhaps a new genus. However, until such elements are discovered, the only course seems to be to put this ancient odontophorine on record, to point out that the bone preserved most closely resembles the corresponding element of *Colinus* and *Lophortyx,* but to leave it unnamed.

I am indebted to Mr. Galbreath for the privilege of examining this fossil, and to Josselyn Van Tyne and Robert W. Storer, of the University of Michigan Museum of Zoology, for the loan of comparative material.—Harrison B. Tordoff, *University of Kansas Museum of Natural History, Lawrence, Kansas, December 18, 1950.*

Least Tern in Southeastern New Mexico.—A study of the bird life in southeastern New Mexico during the summer of 1950 included several trips to the Bitter Lake National Wildlife Refuge, near Roswell, Chaves County. On June 21, a single Least Tern (*Sterna albifrons*) was observed flying over the water. Black Terns (*Chlidonias niger*) were present at the refuge, usually 3 to 5 in number, and farther south along the Pecos River near Artesia, but this was the only occasion on which the Least Tern was observed. This observation is mentioned since Bailey (Birds of New Mexico, 1928) does not report the Least Tern nor have I been able to locate any reference to its occurrence within the state in the available literature. Its presence in eastern New Mexico is not surprising in view of the fact that Nice (The Birds of Oklahoma, 1931) records it as a summer resident in Cimarron County, Oklahoma, and Stevenson (Condor, 44, 1942:111) reported it as a rare migrant in the Texas Panhandle. I have no doubt that more records of this tern will be forthcoming as more water becomes impounded at the refuge or as more ornithologists visit the area. Since no specimen was collected, it should be pointed out that I am very familiar with the two species of tern in all their plumages and that the observation was made under favorable conditions with glasses. I am indebted to the authorities of the New Mexico Military Institute at Roswell, in particular to Major James H. Sikes, who made possible my stay in that region.—Henri C. Seibert, *Department of Zoology, Ohio University, Athens, Ohio, January 15, 1951.*

The Clark Nutcracker in San Diego County, California.—On February 5, 1951, a dead Clark Nutcracker (*Nucifraga columbiana*) was discovered by Bayard H. Brattstrom, hanging by its bill on an incense cedar, *Libocedrus decurrens,* at 6100 feet elevation on South Cuyamaca Peak, San Diego County, California. The bird was found with its bill imbedded one and one-half inches between the cracks in the bark of the tree. One-half inch of the hole was made by the impression of the bill

itself. The bird was located about five feet above the ground on the east side of the tree which had been partly burned in a recent (August, 1950) fire. When skinned by Laurence M. Huey, no damage was found other than freezing. The bird had probably been dead for several days. It is the opinion of the writers that the bird was not "placed" in the tree as might be suspected. No tracks of any humans were seen in the snow about the area.

The Clark Nutcracker has been recorded from the Laguna Mountains, San Diego County, in 1877 by Willett (Pac. Coast Avif. No. 7, 1912:69) and in 1920 by Fortiner (Condor, 22, 1920:190).

The specimen is now in the Ornithological Collection of the San Diego Society of Natural History.—BAYARD H. BRATTSTROM *and* JAMES R. SAMS, *San Diego Society of Natural History, San Diego, California, February 15, 1951.*

Pleistocene Duck Bones from Ohio.—Bones of an anatine duck from Pleistocene lake beds at Lockland, Hamilton County, Ohio, were recently sent me by Donald Baird, Curator of the University of Cincinnati Museum. Explaining the occurrence, Mr. Baird stated that the bones "were found in sediments deposited in water ponded against the face of the Wisconsin ice sheet."

The specimens, paired humeri and coracoids, and fragments of furcula and sternum, apparently all belonged to one individual. The species represented can, without doubt, be assigned to the genus *Anas*. The coracoids agree favorably with specimens of *Anas acuta*. The humeri, however, are heavier. Although shorter than available specimens of *Anas platyrhynchos*, they are relatively as broad, and, across the shaft, they are even broader than in that species.

Variations are so numerous within the ducks, and the species of *Anas* generally so similar that the naming of a new species on the basis of the proportions of these humeri is considered unwise. It should be noted, however, that among the anatine bones examined from Fossil Lake, Oregon, there were three which, although shorter than Mallard bones, were very stout. Possibly future discoveries will reveal more occurrences of this nature. Therefore, measurements of the Ohio bones are recorded here: Humerus: length, 86.5 mm., breadth of proximal end, 19.8 mm., breadth of distal end, 13.8, breadth of shaft at middle, 7.5 mm. Coracoid: length, 47.0 mm., breadth of furcular facet, 7.1 mm., breadth below furcular facet, 7.8 mm. The bones bear the University of Cincinnati Museum number 25698.—HILDEGARDE HOWARD, *Los Angeles County Museum, Los Angeles, California, January 17, 1951.*

The Painted Redstart at Santa Barbara, California.—On January 12, 1951, Mrs. D. Irma Cooke of the Santa Barbara Museum of Natural History asked me excitedly to identify a peculiar looking bird that she said was feeding with some juncos outside the Junior Department of the Museum. I went with her and saw foraging on the trunks of the coast live oaks a Painted Redstart (*Setophaga picta*). It was working on the trunks of the trees somewhat like a nuthatch.

I went immediately for a collecting gun but when I returned the bird was gone. Although other members of the Museum Staff and I watched carefully we never saw it again.

Dr. John Davis of Pasadena reports that on January 14, 1951, while walking on the Museum grounds in Santa Barbara, he saw a Painted Redstart foraging in the coast live oaks. This was undoubtedly the same individual; although we redoubled our efforts to find the bird it was never seen again.—EGMONT Z. RETT, *Santa Barbara Museum of Natural History, Santa Barbara, California, February 2, 1951.*

Autumn Bird Notes from the Charleston Mountains, Nevada.—On October 21 and 22, 1949, the writers visited Kyle Canyon in the Charleston Mountains, Nevada National Forest. Kyle Canyon is about 35 miles northwest of Las Vegas in Clark County, Nevada. We were interested in obtaining fresh fall specimens of certain races of birds described by van Rossem from this range for comparisons with Arizona populations to the east. The summary of van Rossem's work in these mountains (Pac. Coast Avif. No. 24, 1936) permits some interesting comparisons of our records with his, which were mostly made earlier in the fall.

A Yellow-shafted Flicker (*Colaptes auratus borealis*) was collected near the ranger station at the mouth of the canyon on October 21. None was obtained by van Rossem, who cited (p. 27) possible sight records of this form. Our bird was alone; it flew low overhead and alighted on the ground near buildings in the lower yellow pine belt. Other flickers seen were of the *collaris* type.

Only two White-breasted Nuthatches (*Sitta carolinensis*) were seen on our trips and one other was heard. Both specimens were taken and proved to be of the resident race *tenuissima*. If there had been any migration of *nelsoni* through the yellow pine belt in 1949, the birds must have passed on before our visits.

Pigmy Nuthatches (*Sitta pygmaea*) were abundant throughout the pine belt. At its upper limit, from a loose flock of this noisy little bird, we took seven specimens. These do not appear to differ significantly from the birds of northwestern and central-eastern Arizona. They are at least as brown on the hind-neck beside the concealed whitish spot as are the Arizona birds, despite their current recognition as a distinct race (*canescens*) on the basis of grayer head and hind-neck. The crown becomes grayer (less brown) with wear.

Although we were constantly on the lookout for Brown Creepers (*Certhia familiaris*), none was seen or heard. The weather was crisp and cold, and snow lay on the ground at elevations as low as the piñon-juniper belt. It is doubtful, however, that severity of the weather was at all extreme for these birds or that there had been any considerable migration. It would seem that this species must be quite rare in Kyle Canyon, if indeed it winters there.

A flock of Golden-crowned Kinglets (*Regulus satrapa*) was discovered almost immediately on our arrival at the upper picnic area at the upper edge of the yellow pine belt. It was estimated that there were about a dozen in the loose flock. Seven specimens taken are greenish-backed birds, one or two females being pale enough for *R. s. amoenus*; the others do not differ greatly from fresh fall specimens of *R. s. apache*. So far as we are aware, this species has not been recorded before from this range nor from Clark County. Previous Nevada records are all from the northeastern part of the state, much farther north (Linsdale, Pac. Coast Avif. No. 23, 1936:100). Ruby-crowned Kinglets (*Regulus calendula*) were more generally distributed.

Although the Cassin Finch (*Carpodacus cassinii*) was recorded as common by van Rossem (*op. cit.*: 52), we found only one flock of about a half dozen birds; this was on October 21, in the mountain mahogany belt below the ranger station. At the upper picnic area the same day, one or two Pine Siskins (*Spinus pinus*) were heard flying overhead. Aside from this we noted no other finches, nor any other fringillids except *Junco* and *Zonotrichia*.—Warren M. Pulich, *Boulder City, Nevada, and* Allan R. Phillips, *Tucson, Arizona, December 15, 1950.*

The Identity of Two Asiatic Birds Recorded from Nunivak Island, Alaska.—On the basis of specimens taken in 1927 by C. G. Harrold for the California Academy of Sciences, Swarth (Proc. Calif. Acad. Sci., ser. 4, 17, 1928:251) recorded an Old World warbler and an accentor from Nunivak Island as additions to the list of North American birds. While the specific identifications were valid when published, more recent studies have divided both into subspecies, so that it has become important to compare the original specimens again with series from eastern Asia. Dr. Robert T. Orr of the Academy has kindly forwarded the skins to Washington for examination, since comparative material was not available in California.

The first of these birds, taken on Nunivak September 15, 1927, was reported as Middendorff's Grasshopper-Warbler, *Locustella ochotensis* (Middendorff). Two forms are now recognized, differing mainly in length of bill, the culmen from the base in *L. o. ochotensis* measuring 15.5 to 17 mm., and in *L. o. pleskei* Taczanowski 18.5 to 20.0 mm. The Nunivak specimen, having the culmen 15.8 mm., belongs definitely with typical *ochotensis*.

Meise (Ornith. Monatsb., 46, 1938:173) considers *ochotensis* conspecific with *Locustella certhiola* (Pallas), but it seems to the writer better to await more detailed information before accepting this proposal. There is no question but that *certhiola* and *ochotensis* are closely related, as indicated by form, size, and tail-markings. They differ definitely, however, in the markings of the dorsal surface, this region being prominently streaked in *certhiola* and almost uniform in *ochotensis* (including *pleskei*). The birds marked by the two kinds of pattern seem to approach one another rather closely in breeding range without evident variation toward one another in the specimens seen. It is quite possible that they may overlap when their distribution is better known. It seems preferable for the present to maintain them as separate species, at least until more definite data on which to unite them is available. The bird from Nunivak therefore is identified as *Locustella ochotensis ochotensis* (Middendorff).

The second specimen, an accentor, recorded as *Prunella montanella* (Pallas), was taken on Nunivak on October 3, 1927. The species as a whole breeds in Siberia north to the limit of trees, its range extending from the Urals to the Pacific Coast, and south to Altai, Transbaikalia and Ussuriland. It winters south to China and Japan. Portenko (Compt. Rend. Acad. Sci., U. S. S. R., 1929, A, no. 9:220) has separated the birds of the Pacific coastal area breeding from the Chokotski Peninsula south to extreme eastern Manchuria (Lake Khanka) as *Prunella montanella badia* (type locality "Tschuktschenland" = Chokotski Peninsula; type in Zoological Museum, Leningrad). In *P. m. montanella* the general appearance of the dorsal area is grayer, and the feathers of the back have distinct dusky shaft streaks. In *P. m. badia* the general appearance is darker, the back being more reddish brown, without dusky shaft streaks and with less evident buffy edgings on the feathers. The specimen from Nunivak agrees with the latter, though very slightly intermediate toward *montanella*. It is identified as *Prunella montanella badia* Portenko.—ALEXANDER WETMORE, *Smithsonian Institution, Washington, D.C., February 5, 1951.*

Pebble-dropping by House Sparrows.—During my high school days at West Point, Nebraska, my father was a merchant occupying a building of two stories with a long pebble-covered, tarred roof sloping to the rear. Forming a short walkway behind the rear entrance were two sloping doors, which, when opened up, admitted entry to the basement stairway. Over a period of several days in mid-May of 1905, I noticed many small pebbles scattered about on these doors. I also heard from time to time the sound of small objects falling on the doors. Efforts to find the pebble-droppers were of no avail until one day when I happened to approach the rear of the building from the alley. My position some fifty feet from the building now permitted me to see several House Sparrows (*Passer domesticus*) bringing small stones to the edge of the roof and dropping them. As each pebble was dropped the bird involved turned its head to one side, apparently the better to listen to it and to watch it as it struck the door. It may have been a sort of bird pastime; it certainly was an activity of no evident value. After about a week I saw no more of it.

In later years I had begun to doubt the correctness of my boyhood observations until a second viewing of this same phenomenon was made on April 10, 1950, in Riverside, California. On this occasion the sparrows were dropping small bits of crushed stone from the roof of a one-story building onto a cement walk. In the first instance six or eight birds were involved; in this recent observation but two birds were "amusing themselves" with pebble-dropping.—EDMUND C. JAEGER, *Department of Zoology, Riverside College, Riverside, California, January 12, 1951.*

Yellow-billed Cuckoo in the San Bernardino Mountains, California.—On June 2, 1950, I observed a Yellow-billed Cuckoo (*Coccyzus americanus*) near Lake Arrowhead, San Bernardino County, California. The area was typical of the upper Transition Zone on the desert slope of the mountains. The bird was approached easily to a distance of about thirty feet as it foraged in manzanita and buckthorn bushes. This sight record is quite unusual, not only for its location but for the altitude of the station which was approximately 5000 feet.—JOHN H. BAUMGARDT, *Pasadena, California, January 15, 1951.*

NOTES AND NEWS

COOPER CLUB MEETINGS

BUSINESS MEETING

The first session of the annual meeting of the members of the Cooper Ornithological Club was called to order in Class Hall, Asilomar, Pacific Grove, at 10:20 a.m. April 20, 1951.

The minutes of the meeting of 1950 were read and approved. The following committees were appointed: to examine proxies, Kenneth E. Stager, John Davis, Thomas Howell; to nominate members of the Board of Directors, Hildegarde Howard, Stanley Jewett, Charles Sibley.

The following applications for membership were read: Mrs. Albert E. Long, 45 Clarendon Ave., San Francisco 14, Calif., by Junea W. Kelly; Mary Pemberton Ford, 2360 Scout Road, Oakland 11, Calif., and Adrienne C. Bentinck, 2420 Scout Road, Oakland 11, Calif., by Susan E. Chattin; Leavitt M. McQuesten, 120 Otis St., Santa Cruz, Calif., by Kenneth E. Stager; Thomas Henry Foster, West Road, Bennington, Vermont, and Merle E. Stitt, 1208 No. Weber, Colorado Springs, Colorado, by C. V. Duff; Mrs. Daisy Eberhardt, 427 East F St., Ontario, Calif., and Thomas M. Raitt, 264 Eugenia Dr., Ventura, Calif., by Sidney B. Peyton; Oscar F. Clarke, 1012 Indianapolis Ave., Riverside, Calif., by Wilson C. Hanna.

The second session was called to order by Dr. Miller at 9:30 a.m., on Saturday, April 21. Mr. Stager, chairman of the Proxy Committee, reported sixty-six members present in person and proxies for 706. A quorum was declared present.

Mr. C. V. Duff, Business Manager, presented a brief report of the financial condition of the club.

Dr. Howard, reporting for the Nominating Committee, presented the following names for nomination to the Board of Directors: C. V. Duff, Ed N. Harrison, Jean M. Linsdale, Alden H. Miller, J. R. Pemberton, Sidney B. Peyton, Frank A. Pitelka, W. J. Scheffler, Kenneth E. Stager. It was moved and voted that those named be elected.—HILDEGARDE HOWARD, *Secretary*.

SOUTHERN DIVISION

FEBRUARY.—The monthly meeting of the Southern Division of the Cooper Ornithological Club was held at the University of Southern California, with vice-president Wade Fox, Jr., presiding. The following names were proposed for membership: William D. Berry, 1651 Ard Eevin Ave., Glendale 2, Calif., by Hildegarde Howard; Mrs. Wm. A. Eckart, P.O. Box 281, Rio Vista, Calif., by W. L. Chambers; William Joseph Kamp, Rio Lindo Motel #5, Chico, Calif., by Tom Rodgers; Miss Velma Adams, 714 O. Oxford, Los Angeles 5, Calif., Thomas G. Appel, 63 Sunnyside Ave., Pleasantville, New York, Doris M. Brenneman, 1740 Walnut St., Berkeley 9, Calif., John Henry Dick, Dixie Plantation, Meggett, S. Carolina, John J. Duff, Jr., 935 E. Harrison, Springfield, Missouri, John G. Erickson, 1268 Louisiana Ave., Minneapolis 16, Minnesota, Denzel Edward Ferguson, 142 Kings Rd., Corvallis, Oregon, Paul C. Finninger, 3305 W. 6th, Topeka, Kansas, George Gordon Gibson, 265 Sheldrake Blvd., Toronto, Ontario, Canada, Miss Pearl Heaps, 1916 Park Ave., Baltimore 17, Maryland, William Robert Hecht, Box 4206, St. Louis 16, Missouri, Marion L. Hundley, 545 West Virginia Ave., Morgantown, W. Virginia, Charles Ellsworth Huntington, 38 Kildeer Rd., Hamden 14, Connecticut, Eugene E. Kenaga, 1629 Isabella Rd., Rt. 5, Midland, Michigan, Mrs. Glen B. Kersey, 647 Gordon Terrace, Chicago 13, Illinois, Wm. H. Mers, 1659 Marlowe Ave., Cincinnati 24, Ohio, Mrs. McBrayer Moore, 335 W. Lexington St., Danville, Kentucky, Clarence B. Randall, 38 S. Dearborn St., Chicago 3, Illinois, Carol Rehfisch, 335 Delgado St., Santa Fe, New Mexico, Keith M. Schreiner, Ollie, Iowa, Mrs. Robert Schultz, 7002 Murray Ave., Seattle 6, Washington, Charles Walsh Schwartz, 131 Forest Hill, Jefferson City, Missouri, Richard Earl Tashian, 178 Canonchet Ave., Gaspee Plateau 5, Rhode Island, and Wynn A. Wilson, 817 Greer St., Fort Worth 3, Texas, all by C. V. Duff.

S. Paul Lindau presented a colored motion picture showing the life cycle of the silver fritillary butterfly and nesting activities of Yellow Warbler, Black-chinned Sparrow, Coot and Gray Vireo.

Subsequent to the meeting, the following committees were appointed by the president: Natural Resources: Luther Little (chairman), Frances L. Cramer, S. Paul Lindau, Robert L. Taylor; Membership: Earle R. Greene (chairman), John Davis, Ross Hardy, Harold M. Hill, Ralph H. Miller; Program: Thomas R. Howell (chairman), Frances F. Roberts, Kenneth E. Stager; Publicity: William R. Laskey (chairman); Research: John Davis (chairman), Wade Fox, Jr., Thomas R. Howell, Robert L. Pyle, Arnold Small, and Kenneth E. Stager.—DOROTHY E. GRONER, *Secretary*.

For Sale, Exchange and Want Column—Each Cooper Club member is entitled to one free advertising notice in any issue of The Condor. Notices of over five lines will be charged for at the rate of 25 cents per line. For this department, address Sidney B. Peyton, R. R. No. 2, Box 260, Fillmore, Calif.

BINOCULAR SERVICES—As binocular specialists since 1923, we offer expert service and technical information. If your glass needs repair or coating, send it in for free estimate. If you need a new one, send for free list of glasses from $12 to $175—all guaranteed adjusted to U.S. Government tolerances and sent on 10 days' free trial. Liberal trade-in. For details how to use, choose and check a binocular, send 25c for illustrated booklet (reprint of our articles recently published in The American Rifleman). We also check glasses without charge and answer questions personally.—MIRAKEL REPAIR CO., *Mount Vernon 15, New York.*

NOTICE—The Ibis, the quarterly journal of the British Ornithologists' Union, is now in its ninety-third year. It deals with ornithology in all parts of the world and publishes annually about 500 pages of original contributions on every aspect of ornithology; it also contains records of all "new birds" and notices of selected publications. The rate for subscribers in the U.S.A. is $9.80 per year, post free. Orders should be addressed to the publishers, MESSRS. TAYLOR AND FRANCIS, *Red Lion Court, London E.C. 4.*

BOOKFINDER—World-wide search for any book on any subject. Send your wants. No obligation. Falconry, hawking, and birds-of-prey our specialty. Lists issued. Original art by famous artists. Books bought and sold.—W. R. HECHT, *Box 4206, St. Louis 16, Missouri.*

WANTED—*Peters' Birds of the World,* vols. 1, 3, and 4, especially; also vols. 5, 6, and 7. Would consider offers of full set.—L. P. RICHARDS, *Museum of Vertebrate Zoology, Berkeley, California.*

CONTENTS OF RECENT ISSUES OF THE CONDOR

May-June, 1951

An Experimental Study of Territorial Behavior in Breeding Red-winged Blackbirds
Robert W. Nero and *John T. Emlen, Jr.*

A Comparison of the Avifaunas of Santa Cruz and Santa Rosa Islands, California
Alden H. Miller

Subspecific Status of the Green Jays of Northwestern Mexico and Southern Texas
George Miksch Sutton

Birds of the Southern Willamette Valley, Oregon.....*Gordon W. Gullion*

March-April, 1951

Results of the Pacific Gull Color-banding Project
Angus M. Woodbury and *Howard Knight*

A Miocene Petrel from California.....*Loye Miller*

Notes on the Birds of New Georgia, Central Solomon Islands.....*Charles G. Sibley*

Notes on Banding Records and Plumages of the Black-headed Grosbeak
Josephine R. Michener and *Harold Michener*

January-February, 1951

Congeneric Species of Birds Nesting Together in Central America....*Alexander F. Skutch*

Birds and an Ant Army in Southern Tamaulipas.....*George Miksch Sutton*

A Cooling Mechanism of the Texas Nighthawk
Raymond B. Cowles and *William R. Dawson*

Osteology of *Colinus hibbardi*, a Pliocene Quail.....*Harrison B. Tordoff*

The Avifauna of Niihau Island, Hawaiian Archipelago.....*Harvey I. Fisher*

Stomach Analysis of a Group of Shorebirds.....*William G. Reeder*

November-December, 1950

Breeding Habits of the Barred Dove in Hawaii with Notes on Weights and Sex Ratios
Charles W. Schwartz and *Elizabeth Reeder Schwartz*

Inhibition with Prolactin of Light-induced Gonad Increase in White-crowned Sparrows
Robert E. Bailey

The Pale Races of the Steller Jay.....*Allan R. Phillips*

Observations on the Lawrence Goldfinch.....*Jean M. Linsdale*

Notes on the Birds of the Lake Patzcuaro Region, Michoacán, Mexico
Robert B. Lea and *Ernest P. Edwards*

September-October, 1950

Clines in Yellow-throats of Western North America.....*William H. Behle*

Life History of the White-breasted Blue Mockingbird.....*Alexander F. Skutch*

Critical Notes on *Limnodromus semipalmatus*.....*A. L. Rand*

Habitat Distribution of Breeding Birds in Southeastern Washington....*Philip C. Dumas*

July-August, 1950

The Metabolism of Hummingbirds.....*Oliver P. Pearson*

Increasing Abundance of Albatrosses off the Coast of California.....*J. L. McHugh*

A Nest of the Mexican Ptilogonys.....*Robert J. Newman*

Waterfowl Populations of a Swamp in Western Oregon
Fred G. Evenden, Jr., David B. Marshall and *Thomas H. McAllister, Jr.*